EPA Comments:

Page 11 – "The 60-mil PVC liner installed on the inboard slope is exposed or covered with CCW (Photos C1 – C5)."

The report had previously stated that the liner on the inboard slope was 60 mil HDPE, not PVC. Please verify and make consistent.

Ameren

Ameren Services

March 2, 2011

Mr. Stephen Hoffman
US Environmental Protection Agency (5304P)
1200 Pennsylvania Avenue, NW
Washington, DC 20460

Re: Ameren Missouri
Labadie Power Station
Response to O'Brien & Gere Draft Dam Safety Assessment of CCW Impoundments

Dear Mr. Hoffman:

Below are Ameren Missouri's responses to the O'Brien & Gere draft dam safety assessment of the coal combustion waste (CCW) impoundments at the Labadie Power Station. The draft report was received by Ameren Missouri from the U.S. EPA on January 31, 2011. We have also enclosed a copy of our recently completed stability analysis of the Labadie CCW impoundments as requested by your consultant. Please note that we have recently revised the designation for our Company from AmerenUE to Ameren Missouri.

Excerpts of the O'Brien & Gere report are presented in bold faced type and our responses are provided in regular type.

5. CONCLUSIONS, Bottom Ash Pond: ...the overall condition of the Bottom Ash pond is considered to be POOR. Because the 2010 subsurface investigation, subsequent piezometers readings and the results of the stability analyses were not available when this draft report was prepared, it is not known if acceptable performance can be expected under all loading conditions.

Response: Ameren Missouri requests that USEPA revise its overall condition characterization as the subsurface investigation, collection of piezometer data, and stability analysis for the Labadie Power Station mentioned in the assessment has now been completed and a copy of the report is enclosed with this letter. The stability analysis report demonstrates that the factor of safety for the bottom ash pond **exceeds** Missouri Department of Natural Resources (MDNR) requirements for both static and seismic cases. Based on these results, we do not believe the Bottom Ash Pond warrants a condition rating of POOR and we request the condition rating be reevaluated prior to issuing the final report.

5. CONCLUSIONS, Bottom Ash Pond: In addition, some deficiencies exist that require repair and/or additional studies or investigations. The deficiencies include the following:

- **Raising of the embankment with CCW material of unknown geotechnical properties.**
- **Seepage along the toe of the western embankment and along the outlet pipe.**
- **Deleterious vegetation along the outboard slope of the western embankment.**

Response: The individual bullet items are discussed below in order.

- The bottom ash pond embankment has performed without issues since it was raised in 1988 and the recently performed subsurface exploration and stability analysis indicate that the dam has an adequate factor of safety.

1901 Chouteau Avenue
PO Box 66149, MC 602
St. Louis, MO 63166-6149
Ameren.com

- This seepage is monitored with routine weekly inspections and will continue to be monitored weekly to ensure that the integrity of the embankment is not compromised. If new or changed conditions occur, actions will be taken to address any problems.
- The vegetation on the western embankment will be removed in 2011.

5. CONCLUSIONS, Fly Ash Pond: ...some minor deficiencies exist that require repair and/or additional studies or investigations. The deficiencies include the following:

- **Animal burrows located along the northern, eastern, and southern embankments.**
- **Erosion of dividing dike crest near discharge of six-inch PVC pipes form Fly Ash Pond into Bottom Ash Pond.**

Response: The individual bullet items are discussed below in order.

- Animal burrows will continue to be identified during weekly inspections and will be backfilled on a regular basis. The Company has established a maintenance program to address this issue.
- Placement of riprap to armor the Fly Ash Pond to Bottom Ash Pond discharge area is planned for 2011.

6.2. LONG TERM IMPROVEMENTS, Bottom Ash Pond: The recommended maintenance/improvement actions are described below.

- **Outboard slopes – remove deleterious vegetation and continue regular maintenance of the slopes.**
- **Additional Studies – no additional studies may be needed. A conclusion will be included in the Final version of this report if the 2010 subsurface investigation and stability analyses is available for review by O'Brien & Gere.**
- **If the Bottom Ash Pond is not taken out of service and replaced with the dry landfill, a seepage collection and monitoring system should be installed along the outboard slope of the western embankment.**

Response: The individual bullet items are discussed below in order.

- We agree. Regular maintenance and vegetation control on the slope will be performed.
- The stability analysis has been completed and is enclosed for your consultant to review.
- We do not believe a seepage collection and monitoring system is warranted at this time. We propose to continue to visually monitor the seepage during weekly inspections and if the condition of the seepage changes, a seepage collection and monitoring system will be further evaluated. In addition, MDNR is in the process of issuing a revised NPDES permit for this facility and preliminary indications are that certain ash management requirements may be included in that permit. Accordingly, Ameren Missouri believes it appropriate to address this issue in the context of those permitting requirements.

6.2. LONG TERM IMPROVEMENTS, Fly Ash Pond: The recommended maintenance/improvement actions are described below.

- **Outboard slopes – repair animal burrows.**
- **Inboard Slopes – remove the small tree growing along the northern portion of the embankment.**
- **Interior crest – repair erosion near discharge end of six-inch diameter PVC pipes.**
- **Additional Studies – no additional studies may be needed, final conclusion will be provided after review of the 2010 subsurface investigation and stability analysis.**

Response: The individual bullet items are discussed below in order.

- We agree. Repairs will be performed on a regular basis.
- We agree. The tree will be removed in 2011.
- We agree. The erosion will be repaired in 2011.
- The stability analysis has been completed and is enclosed for your consultant to review.

Business Confidentiality Claim

We request the Draft Dam Safety Assessment Report for the Labadie Power Station prepared by O'Brien & Gere, as well as our responses to this report remain confidential. We also request the attached Labadie Ash Pond Dam Stability Analysis Report be kept confidential. This request is made in accordance with the procedures described in 40 CFR, Part 2, Subpart B.

When initially submitting support documents to O'Brien & Gere for preparation of their report we also designated the following materials as confidential:

- Original Design Drawings (1967?)
- EIP
- Dam Safety Program for AmerenUE Non-Hydro Facilities
- AmerenUE Dam Inventory Inspection Program
- Phase I Report
- Boring Logs from the "Observation Wells" folder
- October 18, 1966 Boring Logs by Sverdrup, Parcell & Assoc.
- October 21, 1966 Boring Logs by Sverdrup, Parcell & Assoc.
- 2008 and 2009 Inspection Reports
- Weekly Inspection Reports
- 2010 Investigation Report

If you need further information, please feel free to contact me at 314-554-2388.

Sincerely,

Paul Pike

Paul R. Pike
Environmental Science Executive
Environmental Services
T 314.554.2388
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ppike@ameren.com

Enclosures

REITZ & JENS, INC.
CONSULTING ENGINEERS

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phone: 314.993.4132
fax: 314.993.4177
www.reitzjens.com

November 16, 2010

CONFIDENTIAL

Mr. Matt Frerking
Managing Supervisor – Dam Safety
Ameren Missouri
3700 South Lindberg, MC F-604
Sunset Hills, Missouri 63127

RE: Ash Pond Dam Stability Analysis
Labadie Power Station

Dear Mr. Frerking:

This report presents our findings and recommendations from the geotechnical field investigations, laboratory testing, land survey, and slope stability analyses of the dams impounding the ash ponds at the Labadie Power Station. The investigation, testing and analyses was done in general accordance with our proposal dated January 29, 2010, and Ameren Missouri's request for proposal dated December 9, 2009. The purpose of this project is to evaluate the stability of the ash pond dams and conduct the necessary land surveys, subsurface explorations, and laboratory testing to define the critical section at each location. The slope stability analysis conducted was for the load cases required by the Missouri Department of Natural Resources (MDNR). The results of the slope stability analysis were compared to the required safety factors for the type and assumed hazard classification of each dam.

In 2007, Reitz & Jens (RJ) completed the Phase I: AmerenUE Dam Inventory and Inspection Program project. This project was a preliminary study and consisted of determining the existing condition and classification status of the dams at Rush Island, Meramec, Labadie and Sioux Power Stations and developing a site specific inspection program at each power station. The project involved field inspections, surveys, site reconnaissance, research of current registration requirements, and pertinent computations. Site specific recommendations for future inspections were developed which include inspection templates, frequency of monitoring and maintenance recommendations. The study reported that the height of the Labadie Dam was approximately 29.5 feet and that the dam did not fall under the current MDNR regulation that requires all dams 35 feet or more in height to be regulated. The report also found no dwellings downstream of the dams and if regulation were necessary the dams would be categorized within Environmental Site Class III. The MDNR dam safety regulations have not changed since the 2007 report.

SURVEY

A land survey was conducted to determine the elevation profile along the crest of the dam. The extents of the survey were chosen to include the areas with the greatest elevation difference between the crest and the downstream toe and the segments impounding water or unconsolidated sediment. Cross-sections were also surveyed at multiple locations at each plant to determine the slope heights and geometry. The locations of the cross-sections were chosen during a site visit and were selected to represent the tallest and steepest slopes. Some of the cross-sections were located based on input from Ameren and previous experience at the power station. Zahner and Associates, Inc. conducted the survey, as a subcontractor to RJ. At the Labadie Power Station an elevation survey of approximately 9,500 lineal feet of the crest was conducted. Elevation profile measurements were taken at 100 foot intervals. The extents of the elevation profile are shown in Figure 1 and a plot of the measured elevations is presented in Appendix B. A total of five cross-sections were surveyed, two on the fly ash pond and three on the bottom ash pond. Plots of the cross-sections are shown in Appendix A. From the cross-section surveys, the approximate height of the Labadie Dam is 28.75 feet. The dam height surveyed during this project is in close agreement with that found during the Phase I: AmerenUE Dam Inventory and Inspection Program project.

GEOTECHNICAL FIELD INVESTIGATION AND LAB TESTING

Geotechnical field investigations were conducted using rotary drilling and cone penetrometer test (CPT) soundings. The quantity of borings and soundings, and the approximate locations at the power station are shown in Figure 1. The boring locations were selected by RJ based on previous experience at these locations, to fill in gaps were there was no subsurface data, slope geometry and to provide soil profiles representative of as much of the embankment as possible. The elevations of the ground surface at the boring locations were measured by Zahner and Associates, Inc. The borings were made by Terra Drill, Inc. of Dupo, Illinois, as a subcontractor to Reitz & Jens. The borings were advanced through the soil using 4.25-in. I.D. hollow-stem augers. Mud rotary drilling was necessary in all 3 of the auger drilling locations. Holes were backfilled with cement grout, which was tremmied from the bottom to the top.

The CPT soundings were also made by Terra Drill, Inc. using a Geo-probe rig, under a subcontract with Reitz & Jens. The cone penetrometer consists of a 1.5-inch diameter, 100 MPa capacity, electronic piezocone (CPTu), which records tip pressure, sleeve friction and porewater pressure as it is hydraulically pushed into the ground. The testing was carried out according to ASTM D5778. The holes were backfilled the same day with Bentonite pellets.

The field investigation was done under the direction of a Reitz & Jens' geological engineer or geotechnical technician, who determined the sampling intervals and the termination depths, operated the CPT equipment, and logged the borings. The boring logs for the Labadie Power Station are presented in Figures 2-1 to 2-3. Logs of the CPT soundings are presented in Figures 3-1 to 3-8. The keys and notes for the boring logs and CPT soundings are shown in Figures 2-0 and 3-0, in that order.

Samples of subsurface materials were obtained using rotary drilling methods at about 2.5-foot intervals for the first 10 feet, at 5-foot intervals below 10 feet. Two types of samplers were used: 1) a hydraulically pushed, 3-in. O.D., thin-walled Shelby tube sampler (ASTM D-1587); and 2) a 2-in. O.D., split-spoon sampler driven by an automatic hammer in conjunction with a Standard Penetration Test (ASTM D-1586). Published tests have shown that the blow counts from a Standard Penetration Test (SPT) using an automatic hammer are about 75% of the blow counts obtained using a manual 140-lbs. drop hammer, rope and cathead. Manual SPT hammers have been used to develop correlations between SPTs and soil properties, therefore, the blow counts, or N-values, from an automatic hammer should be increased by about one-third in order to use such correlations. The uncorrected blow counts are shown on the boring logs. The disturbed split-spoon samples obtained were visually classified in the field and sealed in glass jars to prevent loss of moisture, for later testing in the laboratory. The relatively undisturbed Shelby tube samples were sealed in the tubes and were extruded from the tubes immediately prior to testing in the lab.

All of the recovered samples were visually described in our laboratory in general accordance with the Unified Soil Classification System and the Standard Test Method for Classification, Description, and Identification of Soils (ASTM D-2487 and D-2488). Index tests were also performed and included: water content and dry unit weight tests (ASTM D-2216). The results of these index tests appear on the individual boring logs. Unconsolidated undrained (UU) triaxial compression tests (ASTM D2850) and consolidated undrained (CU) triaxial compression tests (ASTM D-4767) with pore pressure measurement were performed on selected Shelby tube samples of the fine grained samples, to obtain better measurements of the *in situ* total and effective shear strength properties. The results of the UU and CU triaxial shear strength tests are presented with the boring logs in Figures 2-4 to 2-6.

The field data from the CPT soundings were analyzed in the office using the program CPT-pro, Ver. 5.49 by Geosoft. The program automatically applies corrections for depth, and post/pre-data collection baseline readings. These corrected field data are plotted in the CPT logs, which are field tip resistance (q_c), sleeve friction (f_s) and pore water pressure (u2). Soil type was determined based upon the Robertson (1986) method[1]. Undrained shear strength (s_u) was calculated for cohesive materials based upon the Lunne (1997) method[2]. Equivalent Standard Penetration Test (SPT) N_{60} values were calculated using procedures recommended by Robertson (1986)[1]. The equivalent N_{60} values were used to verify the computed internal friction angle (ϕ) in sands and s_u in fine-grain soils. The estimate of ϕ in coarse soils was based upon the measured q_c values using Bowles (1996).[3] The computed parameters N_{60}, s_u and ϕ are also plotted in the CPT logs.

PIEZOMETER INSTALLATION AND MONITORING

Temporary piezometers were installed to help define the line of seepage through the dam. Two piezometers were installed at Labadie. The piezometers were located as close to the downstream crest as possible, with the tips located in the lower most embankment fill above the native soils. The locations of the piezometers are shown in Figure 1, and descriptions of the tip elevation are noted in the boring logs. PZ-1 was located along the south side of the bottom ash pond where the height of the dam is nearly at its peak. PZ-2 was located along the west side of the bottom ash pond, in an area where seepage has been observed during prior inspections of the embankment by Ameren personnel.

Piezometers were constructed using 1-inch inside diameter Schedule 40 PVC pipe, 0.010-inch factory machine-slotted screen and are capped with a flush mount or above grade well protectors. The bottom 10 feet of the piezometers were screened and backfilled with filter sand.

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[1] Robertson, P.K., et al. (1986), "Use of Piezometer Cone Data," *Proceedings of the ASCE Specialty Conference In Situ 86: Use of In Situ Tests in Geotechnical Engineering*, ASCE.
[2] Lunne, T., Robertson, P.K. and Powell, J.J.M. (1997). *Cone Penetration Testing in Geotechnical Practice*. Published by Blackie Academic * Professional.
[3] Bowles, Joseph E. (1996). *Foundation Analysis and Design*. 5th ed., McGraw-Hill, page 180.

Readings were obtained from the piezometers and compared to the pool elevation. A table containing the piezometer readings is shown below. The temporary piezometers were removed after several readings were obtained and the holes were grouted close with cement grout.

Labadie Power Station

Date	Piezometer	Reading	Groundwater Elevation (ft)	Ground Surface Elevation (ft)	Tip Elevation (ft)	Pond Elevation (ft)
6/28/2010	PZ-1	29.5	467.3	493.6	466.1	485.6
7/7/2010	PZ-1	30.4	466.4	493.6	466.1	-
9/8/2010	PZ-1	31.1	465.7	493.6	466.1	484.8
10/8/2010	PZ-1	27.5	469.3	493.6	466.1	485.3
6/28/2010	PZ-2	19.3	473.0	488.3	467.0	485.6
7/7/2010	PZ-2	19.3	472.9	488.3	467.0	-
9/8/2010	PZ-2	19.8	472.5	488.3	467.0	484.8
10/8/2010	PZ-2	19.9	472.4	488.3	467.0	485.3

LABADIE POWER STATION

The Labadie Power Station is located in northeastern Franklin County, Missouri in the floodplain of the Missouri River. The plant is located north of the City of Labadie on the south bank of the Missouri River at river mile marker 57.5. The floodplain is continuous to the east and west of the plant. To the south of the plant the floodplain terminates into loess covered uplands. The Labadie Dam is a single stage industrial dam. The dam impounds an area of approximately 233-acres for coal combustion ash sedimentation. The perimeter of the dam has a length of approximately 11,700-lineal-feet (lf). The dam forms the perimeter of two impoundments which are separated by an interior levee. The two impoundments are the Bottom Ash and Fly Ash Ponds. The Bottom Ash Pond has an area of approximately 154-acres and the Fly Ash Pond has an area of approximately 79-acres. The area of each impoundment was estimated from an aerial photo.

Design plans for the Bottom Ash Pond were issued for construction in 1969 and construction was completed shortly after. The dam was constructed of compacted earth fill with design slopes of 2 horizontal (H) to 1 vertical (V) upstream slopes and 3 (H) to 1 (V) downstream slopes. The pond dam was raised from its original design approximately 8.5 feet to create additional storage due to the amount of bottom Ash deposited in the pond. The material used for the levee raise consisted of bottom and fly ash and was blended to achieve a permeability of 1×10^{-6} centimeters per second or less.

The Fly Ash Pond was constructed in the mid 1990's. The Fly Ash Pond upstream slopes were built at 2(H) to 1 (V) and 3 (H) to 1 (V). The downstream slopes are primarily 3 (H) to 1 (V) with a short section of 2 (H) to 1 (V) in the northwest corner. The Fly Ash Pond is also lined with a 60 millimeter (MIL) high-density polyethylene (HDPE) liner from the bottom to an elevation of 491-ft. No data was provided regarding the initial geotechnical design assumptions or construction criteria.

Fly Ash Pond

The top of the fly ash pond dam was surveyed along the extents shown in Figure 1. The elevation ranged from 492.7 to 494.0-feet. A plot of the elevation profile along the crest of the dam is also shown in Appendix B. Two cross-sections were also surveyed, and showed upstream and downstream slopes of approximately 3 (H) to 1 (V). The approximate crown width is 20 feet. Drawings showing the measured cross-sections are presented in Appendix A.

CPT soundings were conducted at 6 locations along the fly ash pond. Four were at the crest and 2 were at the toe. Soundings in the crest showed that the embankment soils are very heterogeneous and consist of sand, silt and clay generally in 8 to 12 inch layers. The CPT measurements, specifically pore pressure readings, indicate that this material is generally freely draining, although thin clay seams do exist. Typically q_c and f_s increased with depth. For slope stability modeling we dissected the embankment into upper, middle and lower fill. The following table shows depth range and internal angle of friction used for slope modeling of these fills.

Stratum	Depth (ft)	Angle of Internal Friction (ϕ)
Upper Fill	0 to 4	25°
Middle Fill	0 to 21	28°
Lower Fill	15 to 29.5	29°

The foundation soils generally have a thin cohesive cap with the soils becoming coarser and with increasing stiffness or density with depth. Clay soils were found at the ground surface, and at an elevation of the approximate ground surface beneath the embankment, with a thickness of approximately 2 to 5 feet. The clay is moderate to high plasticity. Using correlations for q_c and f_s we estimate the s_u of the clay is 1,000 to 1,500 pounds per square feet (psf). Beneath the clay the soil becomes clayey or sandy silt and the relative density varies from loose to medium-dense. The estimated ϕ for the silt ranges from 25° to 30°. The thickness of the silty soils ranges from approximately 4 to 10 feet. Underlying the silt is poorly graded sand which is medium dense to dense. The relative density of the sand increases with depth, but even for shallow sands we estimate that the ϕ is at least 31°.

Bottom Ash Pond

The top of the bottom ash pond dam was surveyed along the extents shown in Figure 1. The elevation ranged from 492.3 to 494.6-ft. A plot of the elevation profile along the crest of the dam is also shown in Appendix B. Three cross-sections were surveyed, and showed upstream slope of approximately 2 (H) to 1 (V) and downstream slopes of approximately 3 (H) to 1 (V). The approximate crown width is 20 feet. Drawings showing the slope geometry are presented in Appendix A.

CPT soundings were conducted at 2 locations at the top of the embankment. Only one of the soundings was advanced deeper than 9 feet due to the stiffness of the bottom and fly ash fill which make up this portion of the embankment. Two rotary borings were also drilled at the crest of the dam to a depth of 50 feet. One of the locations was on the west side of the pond and the other was on the south side of the pond. Temporary piezometers were installed in these locations. One additional rotary boring was drilled to a depth of 50 feet at the toe of the slope adjacent to the temporary piezometer on the south side of the pond. The locations of the CPT soundings and the rotary borings are shown in Figure 1.

The embankment soils are medium dense to very dense in the top 9 to 10 feet and consist of bottom or fly ash. Beneath the ash fill 1 to 3 foot thick layers of clay, silt and sand were observed. For the granular embankment soils we estimate the ϕ to be 30 to 33°, with the more stiff soils at depth. We have based these estimates on a combination of CU tests, and correlations using N-values, q_c and f_s. For the fine grained embankment soils we estimate s_u ranges from 1400 to 1500 psf, based on UU tests and correlations using N-values, q_c and f_s. The fine grained soils also are generally become stiffer with depth.

The foundation soils were similar to those observed beneath the fly ash embankment on the south and east side of the bottom ash pond. In this area, clay was observed at the ground surface to a depth of approximately 5 feet. The clay is stiff to very stiff and can be silty, and low to high plastic. Using correlations for N-values in clay, we estimate the s_u of the clay to be approximately 1000 to 1500 psf. A clay stratum was not observed beneath the embankment fill on the west side of the pond. Silt and silty sand was observed beneath the clay or embankment fill on the west side of the pond and this stratum had a thickness of approximately 5 to 15 feet. Triaxial shear strength tests on this material show the friction angle to range from 30 to 33°. Sand strata were observed beneath the silt and were medium dense to dense. Based on N-values, q_c and f_s we estimate the ϕ of the sand to be at least 32°.

Slope Stability Analysis Results

The fly ash pond slope stability analysis was run on cross-section 2 for two load cases; steady state seepage, and seismic. Cross-section 2 has a height of approximately 28.75 feet. Steady state seepage was analyzed at full or normal pool, and maximum pool. For the steady state seepage load case it was assumed that no seepage occurs through the HDPE liner. Normal pool was assumed at elevation 484 feet. The maximum pool load case was analyzed assuming the pond level was at the approximate overtopping elevation of 491.3 feet. For the seismic load case a horizontal acceleration of 0.0575 g or 0.25 of the probable maximum acceleration (PMA) was added to the steady state seepage model. The seismic load factor was taken from 10 CSR 22-3 for Franklin County (Zone D) and for an environmental site class III dam.

Cross-section 3 was analyzed for the bottom ash pond and slope stability models were constructed for steady state seepage at full or normal pool and maximum pool, and for seismic loading. The seismic load was identical to that described for the fly ash pond. Cross-section 3 has a height of approximately 26.3 feet. The line of seepage for steady seepage models was created using measured data from piezometer PZ-1 and a theoretical line of seepage using Casagrande's (1937) procedure. The theoretical line of seepage was created due to the varying amount of ash against the upstream slope of the dam. PZ-1 was located in an area with considerable ash on the upstream slope. The theoretical line of seepage may be more appropriate where there is no or little ash against the upstream slope. The theoretical line of seepage was also used to model the maximum pool load case, because piezometric data was not measured at the maximum pool level. The normal pool level was assumed at elevation 485.4. The maximum pool load case assumed the pond level was at approximately elevation 490.9.

The factor of safety for each load case and each section analyzed is summarized in the following table. For Class III Industrial dams the factor of safety exceeds the minimum required by the MDNR. Graphical depictions of the slope stability models and the analysis results are shown in Appendix B.

Labadie Power Station

Load Case	Required Factor of Safety	Factor of Safety	
		Fly Ash Pond	Bottom Ash Pond
Full Reservior, Steady Seepage*	1.5	1.7	2.0
Full Reservior, Steady Seepage**		-	1.5
Maximum Reservior, Steady Seepage**	1.3	1.7	1.3
Earthquake, steady seepage*, full reservior	1.0	1.4	1.7
Earthquake, steady seepage**, full reservior	1.0	-	1.2

*Based on measured piezometric data

**Based on theoretical line of seepage (Casagrande, 1937)

Cross-section 5 was also analyzed for the steady seepage load case at normal pool only. This section was surveyed near the location of PZ-2 and the area where seepage has been observed in the past. The analysis limited the search for a critical failure surface to include "deep" failure surfaces only or slope failures that would require significant effort to repair. The factor of safety for "deep" failure surfaces was approximately 1.7.

CONCLUSIONS

Slope stability analysis conducted on cross-sections from the fly ash and bottom ash ponds showed that the factor of safety for steady seepage and earthquake load cases meet the MDNR minimum required factor of safety for Class III industrial dams. The stability of the embankment slopes are highly influenced by the line of seepage. The line of seepage will vary with the pond level. The line of seepage is also influenced by the amount of ash on the upstream slopes of the pond. Excavation of ash, especially along the south side of the bottom ash pond, or raises in the normal pool level should include the installation of piezometers and monitoring of piezometric levels.

Please let us know if you have any questions regarding this report or any aspects of the project. We appreciate this opportunity to continue our working relationship with Ameren Missouri.

Sincerely,
REITZ & JENS, Inc.

Donald S. Eskridge

Jeff Bertel

Donald S. Eskridge, P.E.
Principal

Jeff Bertel, P.E.
Project Engineer

The following figures are attached and complete this report:

Figure 1	Boring and Survey Location Map
Figure 2-0	Key to Boring Logs
Figure 2-1 to 2-3	Logs of Borings
Figure 2-4 to 2-6	Graphs of CU and UU tests
Figure 3-0	Key to CPT Soundings
Figure 3-1 to 3-8	Logs of CPT Soundings
Appendix A	Cross-sections
Appendix B	Elevation Profile
	Graphical Depictions of Slope Stability Models

Copies submitted: 5

Reitz & Jens, Inc.
Consulting Engineers

Elevation Profile Survey Limits
Locations of Cross-section and Borings

Figure 1

KEY TO BORING LOGS

Symbol Description

KEY TO SOIL SYMBOLS

Crushed Limestone

Miscellaneous FILL

Low plastic Clayey SILT (ML)

Inorganic, non-plastic SILT (ML)

Silty SAND or Sandy SILT (SM)

Poorly-graded SAND (SP)

High plastic CLAY (CH)

MISCELLANEOUS SYMBOLS

Water table during drilling

Boring continues

Moisture content (%)

N-value from Standard Penetration Test, ASTM D-1586 (blows/ft)

SOIL SAMPLERS

2-in. O.D. Split-Spoon

3-in. O.D. Shelby Tube

Notes:

1. Details of the drilling and sampling program are presented in the general introduction of the report

2. Stratification lines shown on the log represent approximate soil boundaries; actual changes in strata may be gradual or occur between samples.

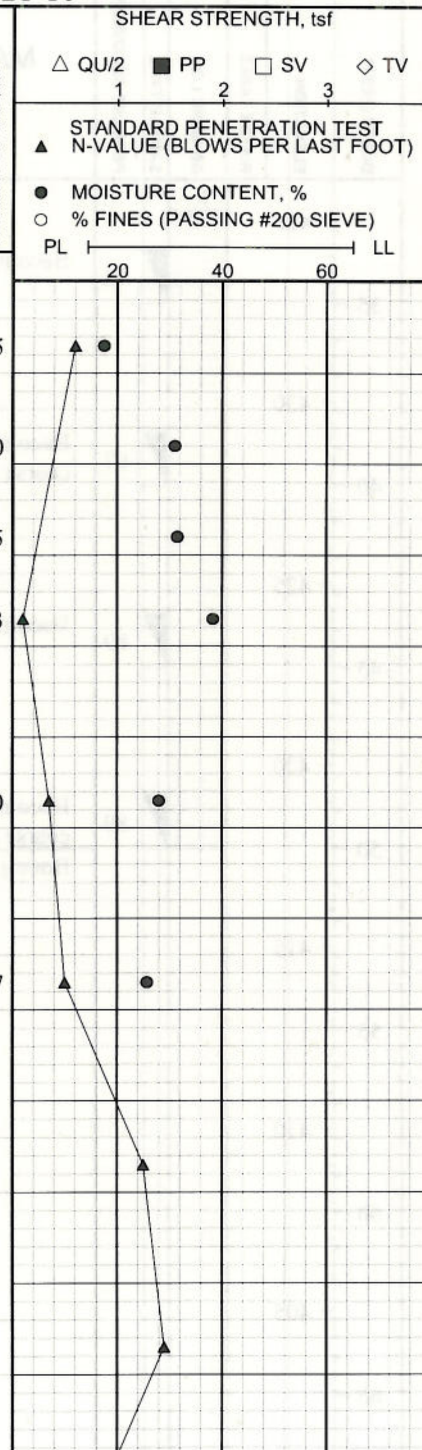
Figure 2-0

REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-1

Ash Pond Stability	LOCATION: N 990518.668 E 725765.215
Labadie Power Plant	ELEVATION: 467.7 DATUM: NAVD88
CLIENT: **Ameren Missouri**	DATE DRILLED: 6-21-10

DEPTH (FEET)	ELEVATION	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) / BLOWS PER 6 INCHES / RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0			8" CRUSHED LIMESTONE, 1-1/2" clean rock		
		78	Fill, gray-brown, very stiff, silty clay, dry, with trace ash	2-4-8	17.5
	465				
		58	Clayey SILT (ML), brown, moist, with very fine sand, fine roots and trace limonite	84.4	31.0
5					
		92	SILT (ML), brownish gray, medium dense, trace clay and very fine sand, soft, very moist	90.2	31.5
	460				
		83	Becoming clayey, stiff	0-1-1	38.3
10			Began mud rotary drilling at 10'		
	455				
		89	Sandy SILT (SM), brown, fine grain, with fine sand lenses, loose	2-4-3	28.0
15					
	450				
		89	Becoming gray, and medium dense	4-4-6	25.7
20					
	445				
		94	SAND (SP), gray, fine grain, trace silt and lignite, dense	6-12-13	
25					
	440				
		89	Without silt	6-10-19	
30					



DRILLER: Terra Drill
METHOD: HSA
TYPE OF SPT HAMMER: Automatic
HAMMER EFFICIENCY (%): 88.6
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 3 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT ____ FEET AFTER ____ HOURS
AT ____ FEET AFTER ____ HOURS

PIEZOMETER: INSTALLED AT __ FEET

File: 2010012488

BORING LOG B-1

REITZ & JENS, INC.
CONSULTING ENGINEERS

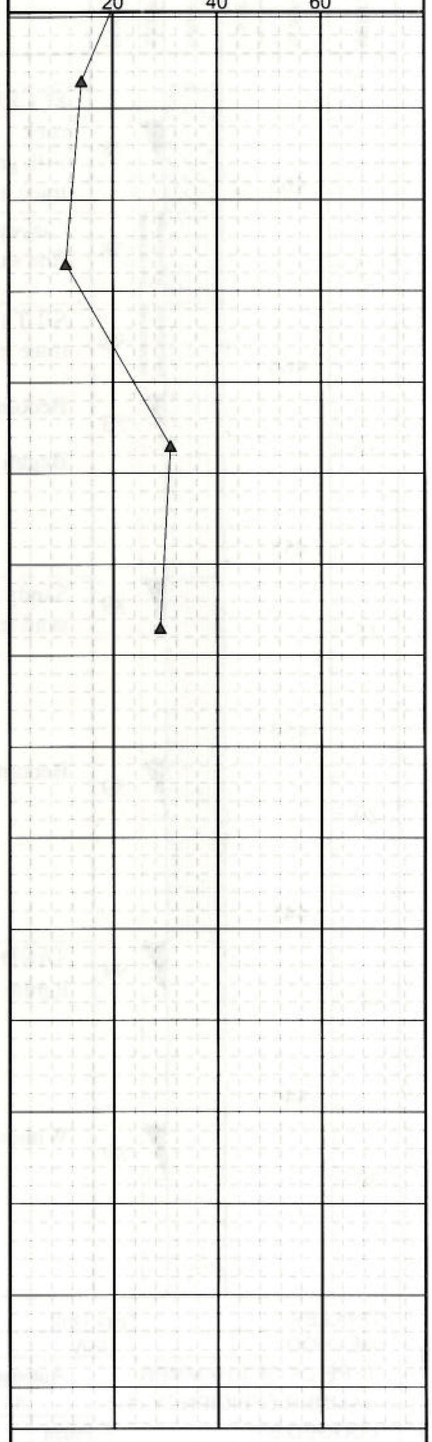
Ash Pond Stability

DEPTH (FEET)	ELEVATION	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) / BLOWS PER 6 INCHES / RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
	435	78	Becoming medium dense	2-5-9	
35	430	67	Becoming fine to medium grain sand, and trace coarse sand	6-5-6	
40	425	89	Becoming dense	9-12-19	
45	420	89	Becoming medium grain sand with fine and coarse grain sand, trace fine gravel	9-12-17	
50			Boring terminated at 50'-0"		

Depth scale: 35, 40, 45, 50, 55, 60, 65, 70
Elevation scale: 435, 430, 425, 420, 415, 410, 405, 400

SHEAR STRENGTH, tsf
△ QU/2 ■ PP □ SV ◇ TV
1 2 3

STANDARD PENETRATION TEST
▲ N-VALUE (BLOWS PER LAST FOOT)
● MOISTURE CONTENT, %
○ % FINES (PASSING #200 SIEVE)
PL ⊢—⊣ LL
20 40 60



File: 2010012488

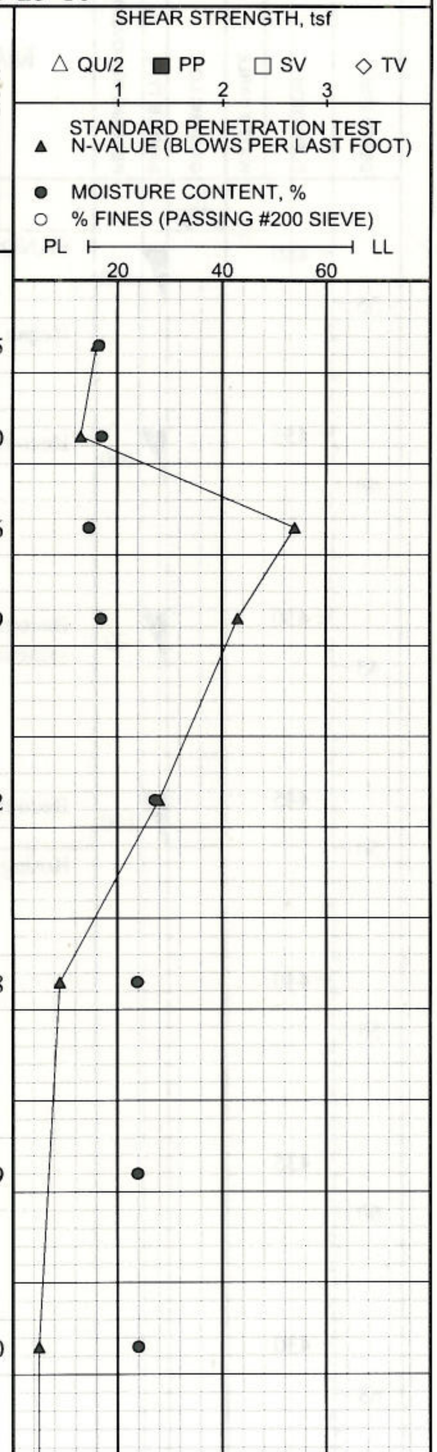
REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG PZ-1

Ash Pond Stability
Labadie Power Plant
CLIENT: **Ameren Missouri**

LOCATION: N 990578.486 E 725699.099
ELEVATION: 493.6 DATUM: NAVD88
DATE DRILLED: 06-25-10

DEPTH (FEET)	ELEVATION	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) / BLOWS PER 6 INCHES / RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0			FILL, consisting mostly of bottom ash, layered with sand, high plastic clay, silty clay and fly ash, medium dense, dry		
		67		2-7-9	16.5
5	490	89		4-6-7	17.0
		100	Becoming very dense	6-22-32	14.6
10	485	89		12-22-21	16.9
15	480	100	Becoming dense, moist	7-11-17	27.2
20	475	100	CLAY (CH), gray, high plastic, with silt and fine sand, stiff	2-3-6	23.8
			PZ-1, screened interval from 22'6" to 27'6"		
25	470	96	Becoming gray-brown and dark grayish tan, with silty clay, clayey silt and very fine sand	98.4	23.9
30	465	100	CLAY (CH), gray-brown, high plastic, with variable silt content, stiff	2-3-6	24.0



DRILLER: Terra Drill
METHOD: HSA/Mud Rotary
TYPE OF SPT HAMMER: Automatic
HAMMER EFFICIENCY (%): 88.6
LOGGED BY: JJP

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 33 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT ____ FEET AFTER ____ HOURS
AT ____ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT __ FEET

File: 2010012488

REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG PZ-1

Ash Pond Stability

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
	460				100	SAND (SP), tan, fine grain, loose	2-3-2	
35						Began mud rotary drilling at 35'		
	455				100	Becoming medium dense	7-10-12	
40								
	450				72	Becoming dense, fine to medium grain with some clay laminations, trace fine gravel	8-16-23	
45								
	445				100	Becoming fine to coarse grain with fine gravel	11-20-23	
50						Boring terminated at 50'-0"		
	440							
55								
	435							
60								
	430							
65								
	425							
70								

SHEAR STRENGTH, tsf

△ QU/2 ■ PP □ SV ◇ TV

1 2 3

▲ STANDARD PENETRATION TEST N-VALUE (BLOWS PER LAST FOOT)

● MOISTURE CONTENT, %

○ % FINES (PASSING #200 SIEVE)

PL LL

20 40 60

File: 2010012488

REITZ & JENS, INC.
CONSULTING ENGINEERS

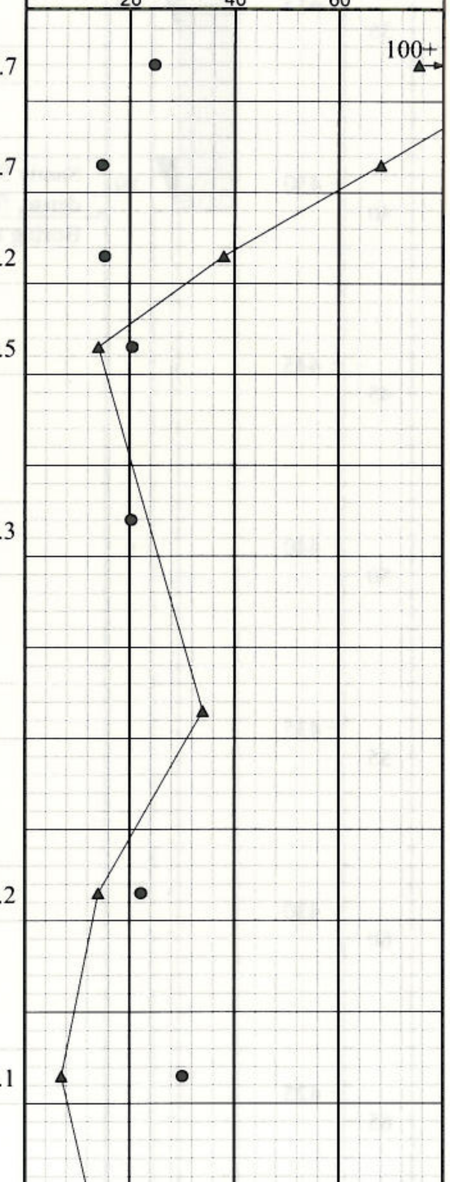
BORING LOG PZ-2

Ash Pond Stability
Labadie Power Plant
CLIENT: **Ameren Missouri**

LOCATION: N 989158.946 E 722726.691
ELEVATION: 489.2 DATUM: NAVD88
DATE DRILLED: 06-23-10

DEPTH (FEET)	ELEVATION	WATER TABLE	SAMPLE TYPE / PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) / BLOWS PER 6 INCHES / RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0				FILL, consisting of bottom ash, fly ash and trace coal, very dense, dry		
			92		18-50/5	24.7
5	485		94		12-28-40	14.7
			100	Trace crushed limestone	10-18-20	15.2
10	480		100	FILL, brown, clayey silt, very stiff, moist	4-6-8	20.5
				PZ-2, screened interval from 11'4" to 21'4"		
15	475	▽	92	Becoming sandy silt, and gray and brown	109.5	20.3
				SAND (SP), tan, fine grain, very dense Began mud rotary drilling at 15.5'		
20	470		94		10-18-16	
25	465		100	Silty SAND (SM), gray, fine grain, medium dense	2-6-8	22.2
30	460		100	Becoming tan-brown, loose, very moist	1-2-5	30.1

SHEAR STRENGTH, tsf
△ QU/2 ■ PP □ SV ◇ TV
1 2 3
▲ STANDARD PENETRATION TEST N-VALUE (BLOWS PER LAST FOOT)
● MOISTURE CONTENT, %
○ % FINES (PASSING #200 SIEVE)
PL ├──┤ LL
20 40 60



DRILLER: Terra Drill
METHOD: HSA/Mud Rotary
TYPE OF SPT HAMMER: Automatic
HAMMER EFFICIENCY (%): 88.6
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 14.5 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT ____ FEET AFTER ____ HOURS
AT ____ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT __ FEET

File: 2010012488

Reitz & Jens, Inc.
CONSULTING ENGINEERS

BORING LOG PZ-2

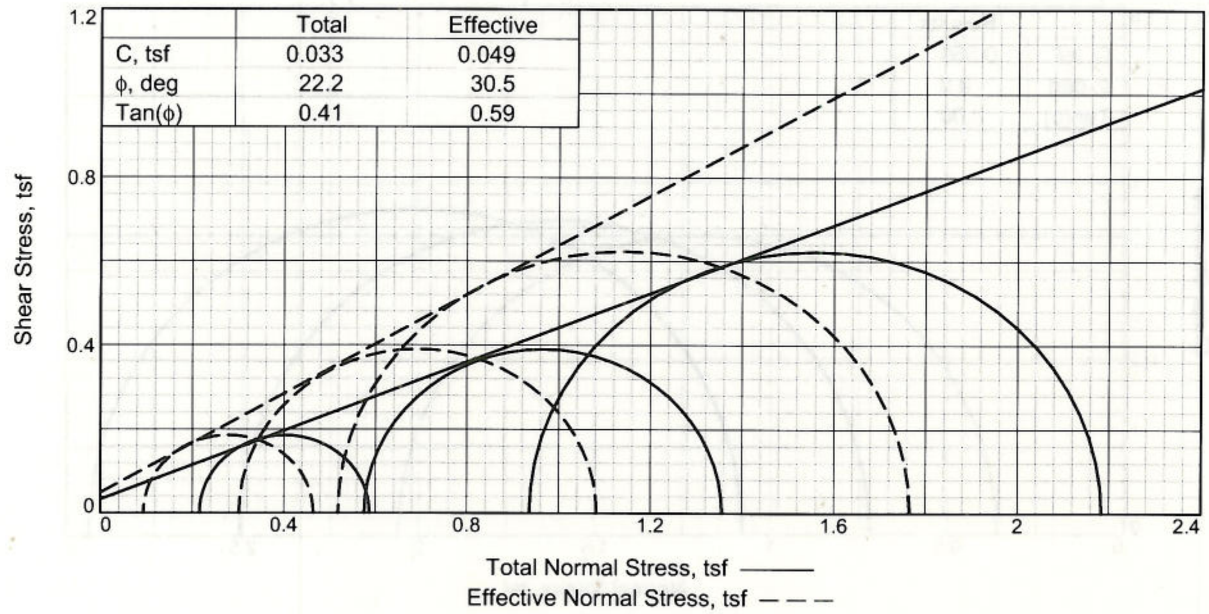
Ash Pond Stability

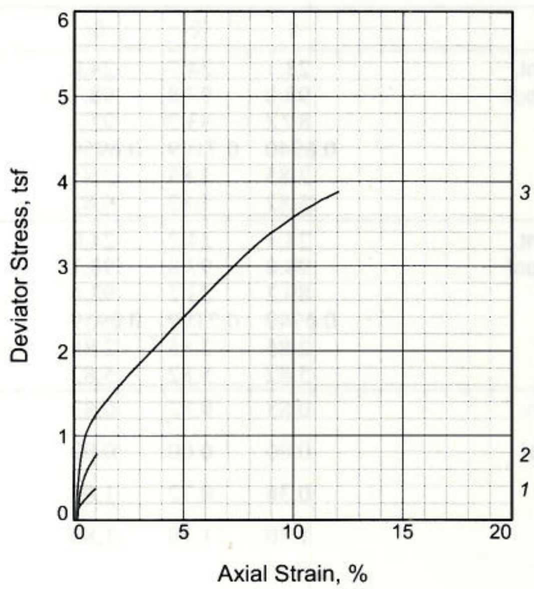
DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD=ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
	455				78	Becoming medium dense	5-7-8	
35								
	450				89	Sandy SILT (SM), medium-gray, medium dense, fine sand, with trace carbon and clay	1-3-7	52.9
40						Boring terminated at 40'-0" in silty sand		
	445							
45								
	440							
50								
	435							
55								
	430							
60								
	425							
65								
	420							
70								

SHEAR STRENGTH, tsf
△ QU/2 ■ PP □ SV ◇ TV
1 2 3
▲ STANDARD PENETRATION TEST N-VALUE (BLOWS PER LAST FOOT)
● MOISTURE CONTENT, %
○ % FINES (PASSING #200 SIEVE)
PL LL
20 40 60

File: 2010012488

Figure 2-3 Sheet 2 of 2





	Sample No.	1	2	3
Initial	Water Content,	31.4	31.4	31.4
	Dry Density, pcf	89.3	89.3	89.3
	Saturation,	96.5	96.5	96.5
	Void Ratio	0.8733	0.8733	0.8733
	Diameter, in.	2.85	2.85	2.85
	Height, in.	5.82	5.82	5.82
At Test	Water Content,	32.2	31.9	31.7
	Dry Density, pcf	89.8	90.2	90.5
	Saturation,	100.0	100.0	100.0
	Void Ratio	0.8637	0.8549	0.8491
	Diameter, in.	2.85	2.86	2.87
	Height, in.	5.81	5.75	5.68
	Strain rate, %/min.	0.05	0.05	0.05
	Back Pressure, tsf	3.96	4.32	5.04
	Cell Pressure, tsf	4.18	4.90	5.98
	Fail. Stress, tsf	0.37	0.78	1.25
	Total Pore Pr., tsf	4.08	4.59	5.46
	Ult. Stress, tsf			3.88
	Total Pore Pr., tsf			4.51
	$\bar{\sigma}_1$ Failure, tsf	0.46	1.08	1.77
	$\bar{\sigma}_3$ Failure, tsf	0.09	0.30	0.52

Type of Test:
CU with Pore Pressures

Sample Type: Shelby Tube

Description: SILT (ML), brownish grey, slightly clayey, traces of fine sand, highly laminated near bottom of sample

Assumed Specific Gravity= 2.68

Remarks:

Client: Ameren Missouri

Project: Ash Pond Stability

Source of Sample: B-1 **Depth:** 6

Sample Number: ST-3

Proj. No.: 2010012488 **Date:** 6/25/2010

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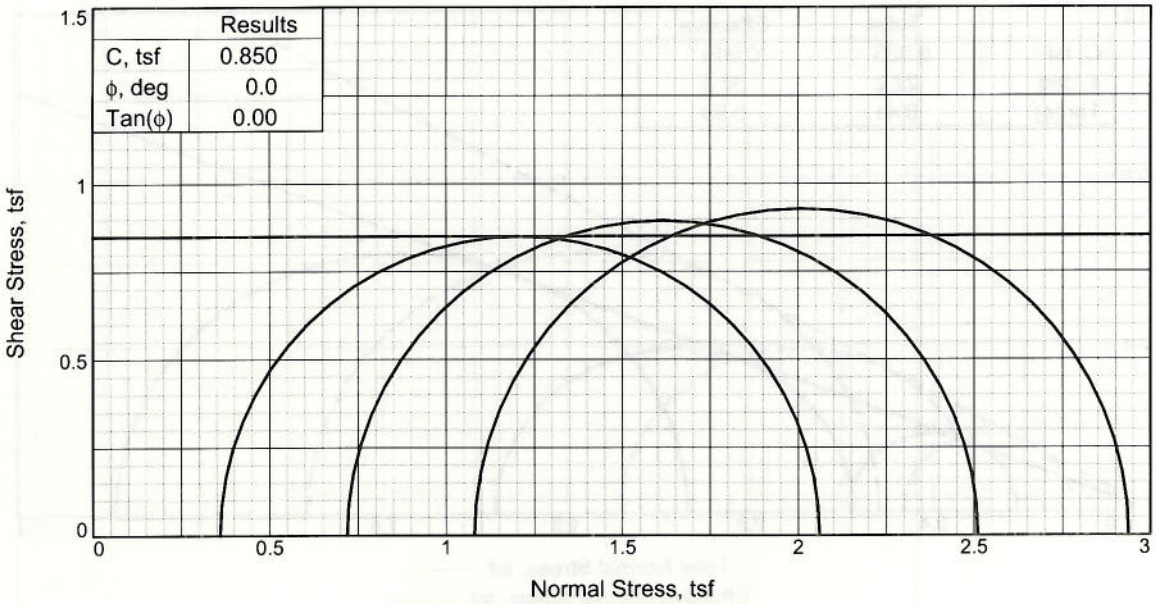
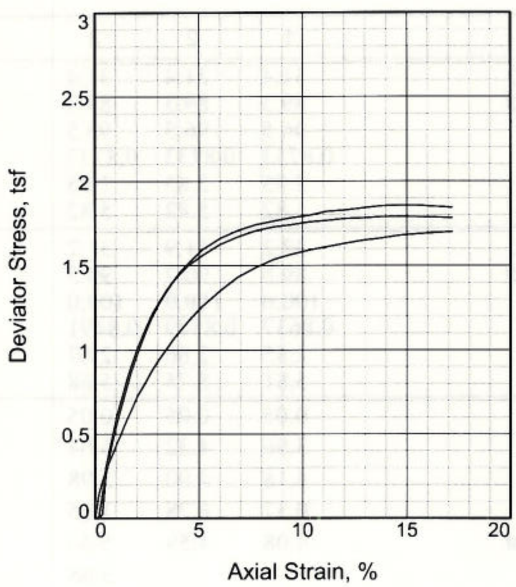
Figure 2-4

Tested By: K. Kocher **Checked By:** J. Bertel





	Sample No.	1	2	3
Initial	Water Content,	23.1	24.7	24.0
	Dry Density, pcf	98.8	97.8	98.7
	Saturation,	89.2	93.2	92.4
	Void Ratio	0.6940	0.7109	0.6959
	Diameter, in.	2.85	2.85	2.85
	Height, in.	5.82	5.82	5.82
At Test	Water Content,	23.1	24.7	24.0
	Dry Density, pcf	98.8	97.8	98.7
	Saturation,	89.2	93.2	92.4
	Void Ratio	0.6940	0.7109	0.6959
	Diameter, in.	2.85	2.85	2.85
	Height, in.	5.82	5.82	5.82
	Strain rate, %/min.	0.83	0.83	0.83
	Back Pressure, tsf	0.00	0.00	0.00
	Cell Pressure, tsf	0.36	0.72	1.08
	Fail. Stress, tsf	1.70	1.79	1.86
	Ult. Stress, tsf			
	σ_1 Failure, tsf	2.06	2.51	2.94
	σ_3 Failure, tsf	0.36	0.72	1.08

Type of Test:
Unconsolidated Undrained

Sample Type: Shelby Tube

Description: Clay FILL (CH), dark gray and grayish tan, silty clay, clayey silt and high plasticity clay, with very fine sand and trace

Assumed Specific Gravity= 2.68

Remarks:

Client: Ameren Missouri

Project: Ash Pond Stability

Source of Sample: PZ-1 **Depth:** 23.5

Sample Number: 7

Proj. No.: 2010012488 **Date:** 07-28-10

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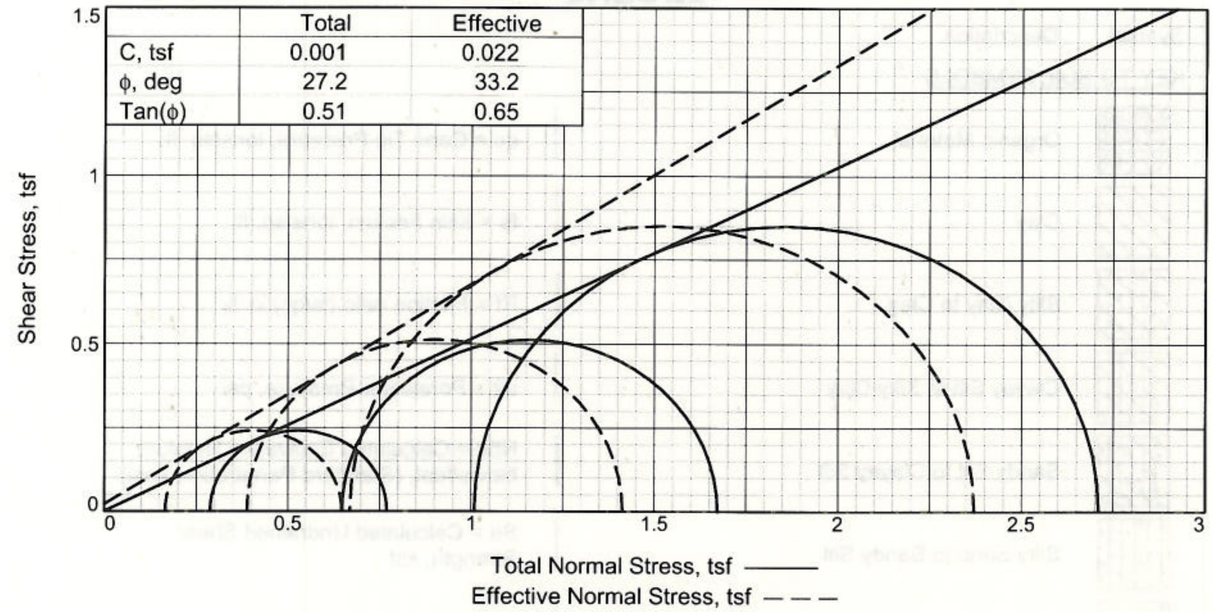
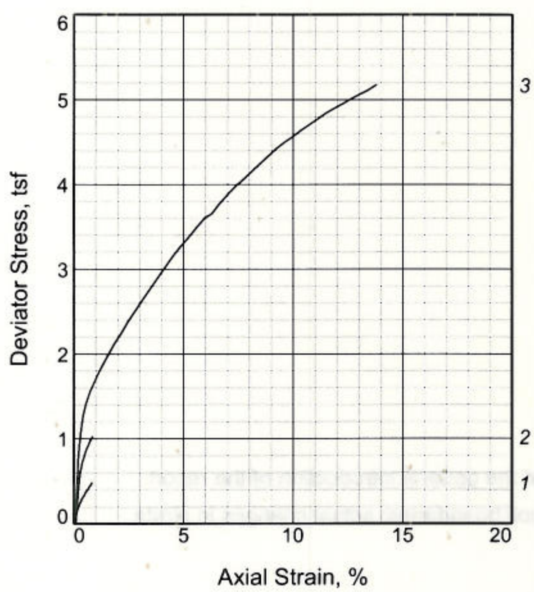
Figure 2-5

Tested By: J. David/J. Pruett



	Total	Effective
C, tsf	0.001	0.022
ϕ, deg	27.2	33.2
Tan(ϕ)	0.51	0.65



	Sample No.	1	2	3
Initial	Water Content,	20.3	20.3	20.3
	Dry Density, pcf	109.5	109.5	109.5
	Saturation,	103.0	103.0	103.0
	Void Ratio	0.5274	0.5274	0.5274
	Diameter, in.	2.85	2.85	2.85
	Height, in.	5.82	5.82	5.82
At Test	Water Content,	19.6	19.6	19.4
	Dry Density, pcf	109.7	109.7	110.1
	Saturation,	100.0	100.0	100.0
	Void Ratio	0.5251	0.5251	0.5203
	Diameter, in.	2.85	2.86	2.87
	Height, in.	5.82	5.77	5.71
	Strain rate, %/min.	0.05	0.05	0.05
	Back Pressure, tsf	3.96	4.32	5.04
	Cell Pressure, tsf	4.25	4.97	6.05
	Fail. Stress, tsf	0.48	1.02	1.70
	Total Pore Pr., tsf	4.08	4.58	5.38
	Ult. Stress, tsf			5.18
	Total Pore Pr., tsf			4.12
	$\bar{\sigma}_1$ Failure, tsf	0.65	1.41	2.37
	$\bar{\sigma}_3$ Failure, tsf	0.17	0.39	0.67

Type of Test:
CU with Pore Pressures

Sample Type: Shelby Tube

Description: Sandy silt FILL (SM), brown and grey, with clay

Assumed Specific Gravity= 2.68

Remarks:

Client: Ameren Missouri

Project: Ash Pond Stability

Source of Sample: PZ-2 **Depth:** 13.5

Sample Number: ST-5

Proj. No.: 2010012488 **Date:** 6/25/2010

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CONSULTING ENGINEERS

Figure 2-6

Tested By: K. Kocher **Checked By:** J. Fouse

LEGEND

Symbol Description

KEY TO SOIL SYMBOLS

- Organic Material
- Clay
- Silty Clay to Clay
- Clayey Silt to Silty Clay
- Sandy Silt to Clayey Silt
- Silty Sand to Sandy Silt
- Sand to Silty Sand
- Sand
- Gravelly Sand to Sand

qc = Cone Tip Pressure, tons/sq. ft.

fs = Skin Friction, tons/sq. ft.

Rf = Friction ratio (fs/qc) in %

u2 = Porewater Pressure, psi

N60 = Calculated Equivalent N-value, blows/foot, (Standard Penetration Test)

Su = Calculated Undrained Shear Strength, ksf

Phi = Friction Angle, degrees

Notes:

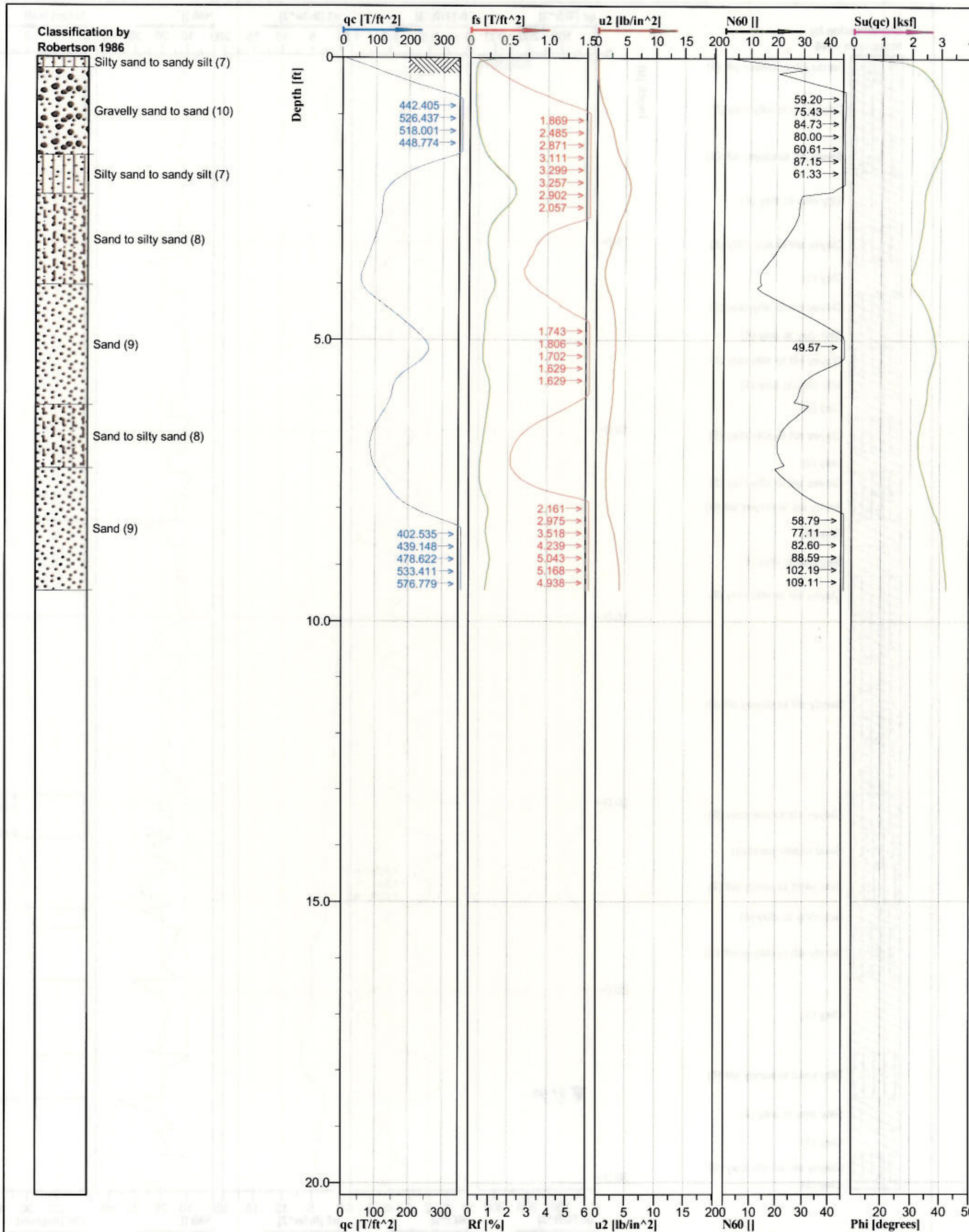
1. Details of the drilling and sampling program are presented in the general introduction of the report.
2. Stratification lines shown on the log represent approximate soil boundaries; actual changes in strata may be gradual.

[1] Robertson et al. (1986) *Use of piezometer cone data.* Proceedings of the ASCE Specialty Conference: In Situ 86: Use of In Situ Tests in Geotechnical Engineering. ASCE 1986

[2] Lunne, T. Robertson, P.K. and Powell, J.J.M. (1997) Cone Penetration Testing in Geotechnical Practice, Published by Blackie Academic & Professional.

[3] Bowles, Joseph E. (1996) Foundation Analysis and Design. McGraw-Hill. 5th ed. Page 180.

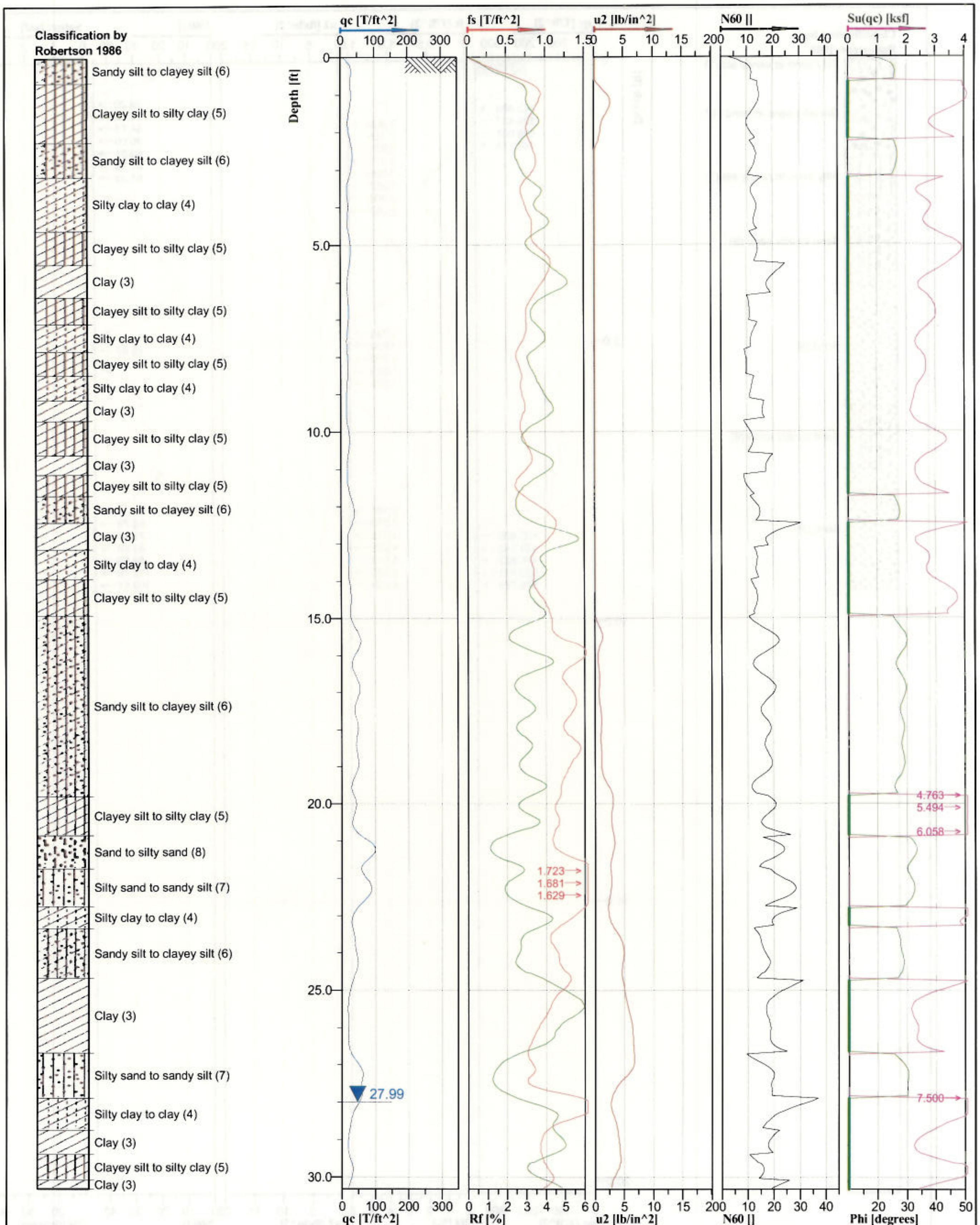
Figure 3-0



Cone No: 4274
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Labadie Power Plant	Position: X: 725910.99 ft, Y: 990746.00 ft	Ground level: 493.50	Test no: P-1
Project ID: 2010012488	Client: Ameren Missouri	Date: 6/23/2010	Scale: 1 : 28
Project: Ash Pond Stability Analysis		Page: 1/1	Fig: 3-1
Boring terminated at 9.5' due to augers pulling out.		File: P-1.cpd	

Reitz & Jens, Inc.
Consulting Engineers

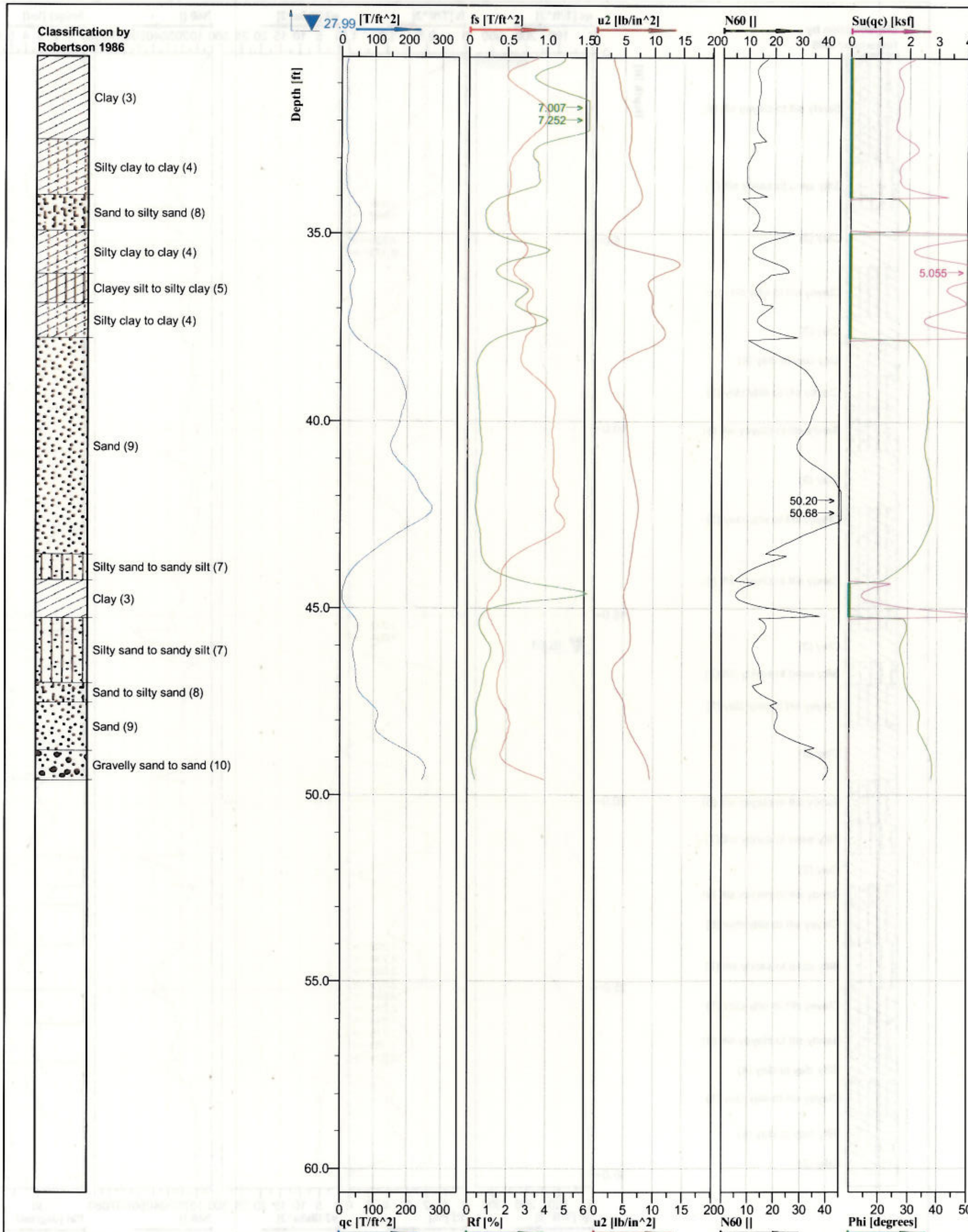


Location: Labadie Power Plant	Position: X: 726264.53 ft, Y: 991560.33 ft	Ground level: 492.78	Test no: P-2
Project ID: 2010012488	Client: Ameren Missouri	Date: 6/23/2010	Scale: 1 : 42
Project: Ash Pond Stability Analysis		Page: 1/2	Fig: 3-2
		File: P-2.cpd	

U2

Cone No: 4274
Tip area [cm2]: 10
Sleeve area [cm2]: 150

REITZ & JENS, INC.
CONSULTING ENGINEERS



U2

Cone No: 4274
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Labadie Power Plant	Position: X: 726264.53 ft, Y: 991560.33 ft	Ground level: 492.78	Test no: P-2
Project ID: 2010012488	Client: Ameren Missouri	Date: 6/23/2010	Scale: 1 : 42
Project: Ash Pond Stability Analysis		Page: 2/2	Fig: 3-2
		File: P-2.cpd	

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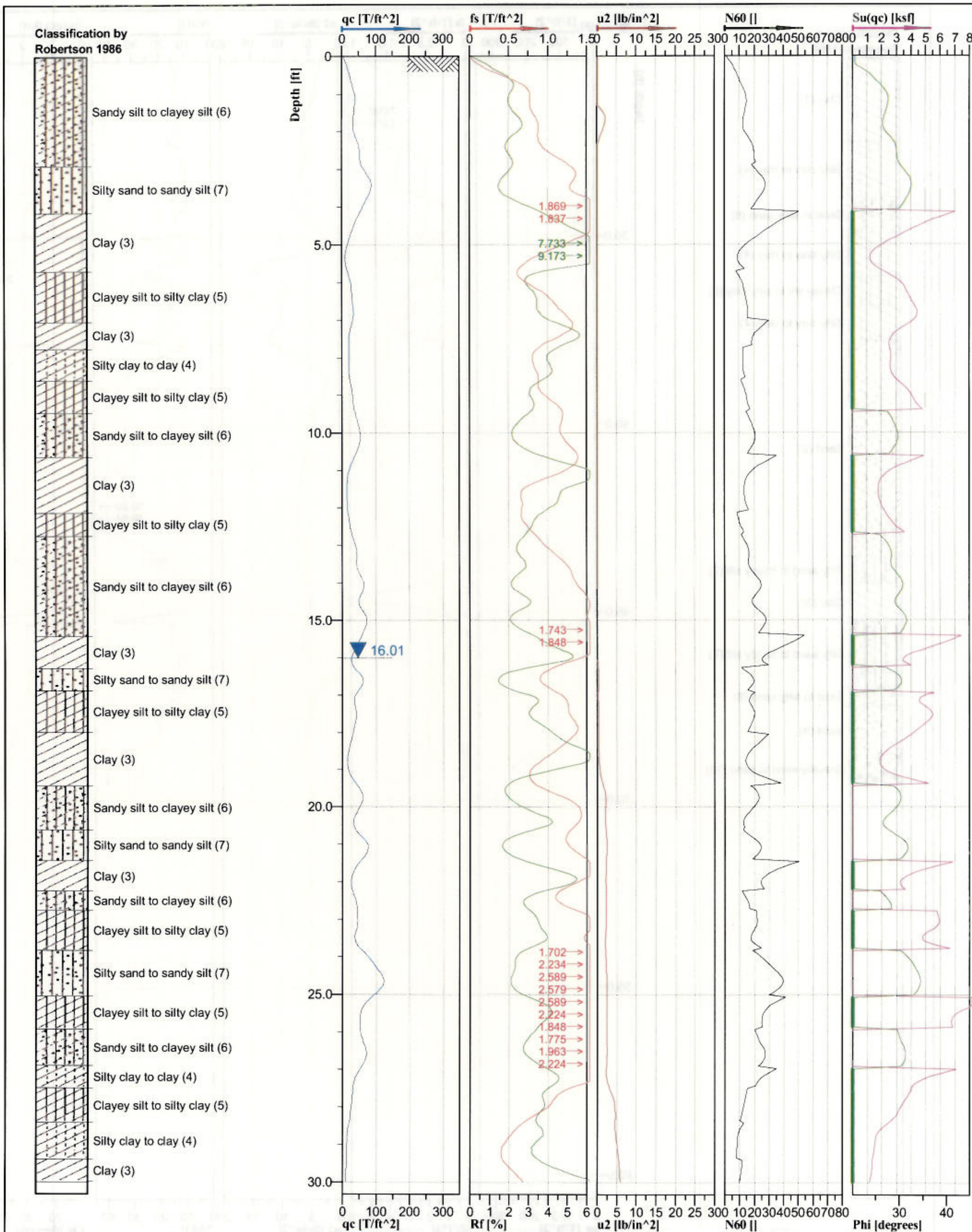
CONSULTING ENGINEERS



Cone No: 4274
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Labadie Power Plant	Position: X: 726283.89 ft, Y: 992395.37 ft	Ground level: 492.49	Test no: P-3
Project ID: 2010012488	Client: Ameren Missouri	Date: 6/23/2010	Scale: 1 : 42
Project: Ash Pond Stability Analysis		Page: 1/1	Fig: 3-3
		File: P-3.cpd	

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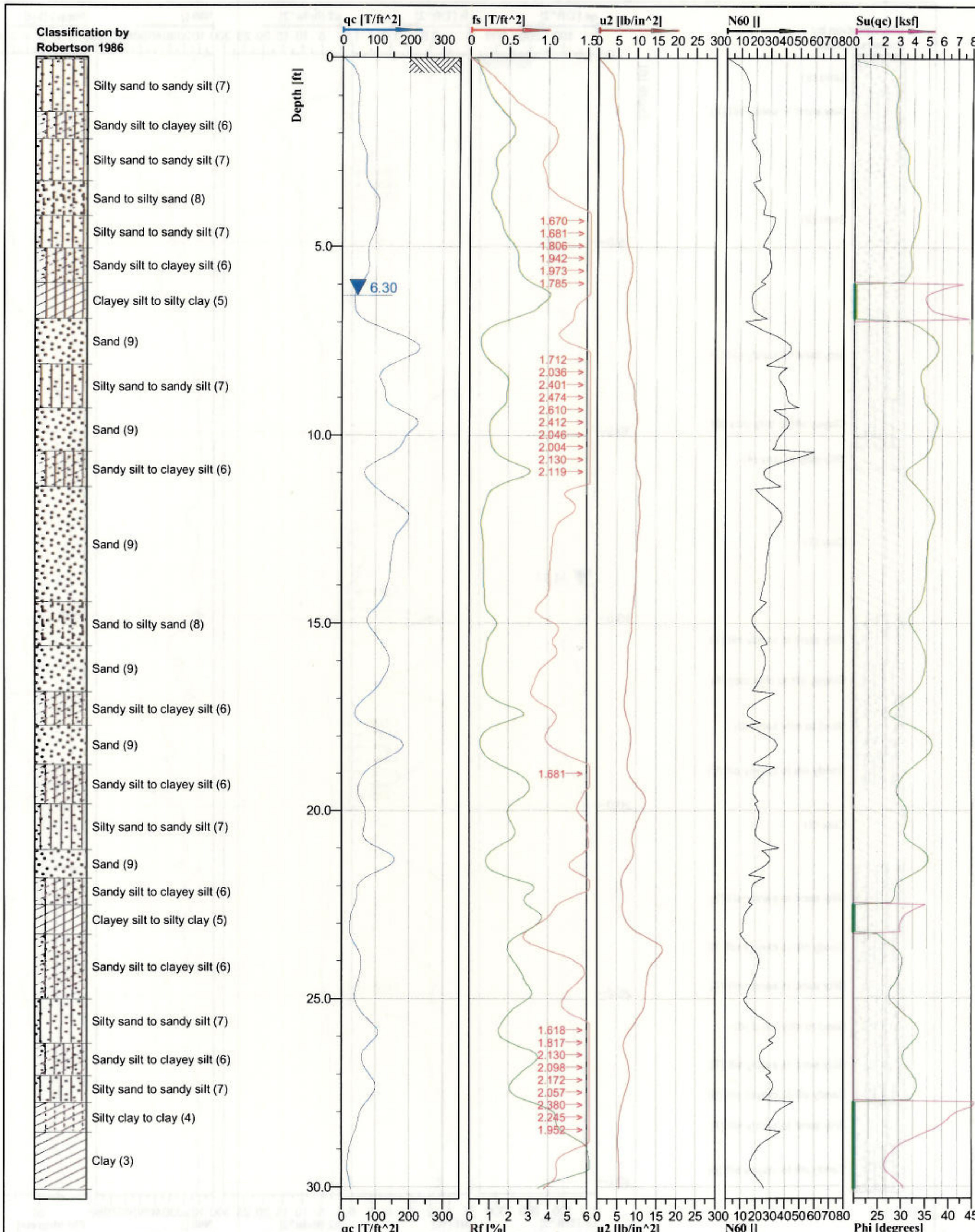

Cone No: 4274
Tip area [cm2]: 10
Sleeve area [cm2]: 150

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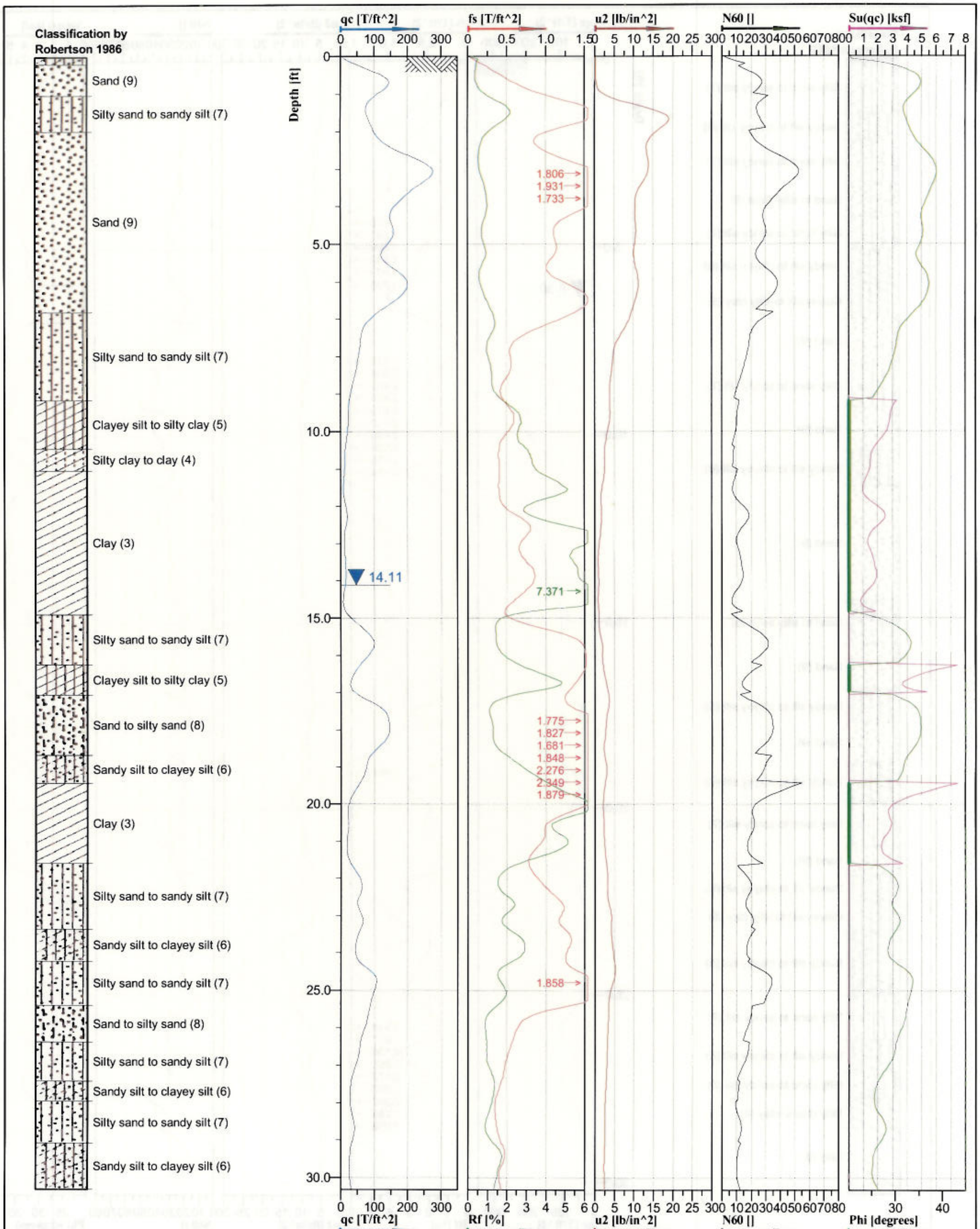
CONSULTING ENGINEERS

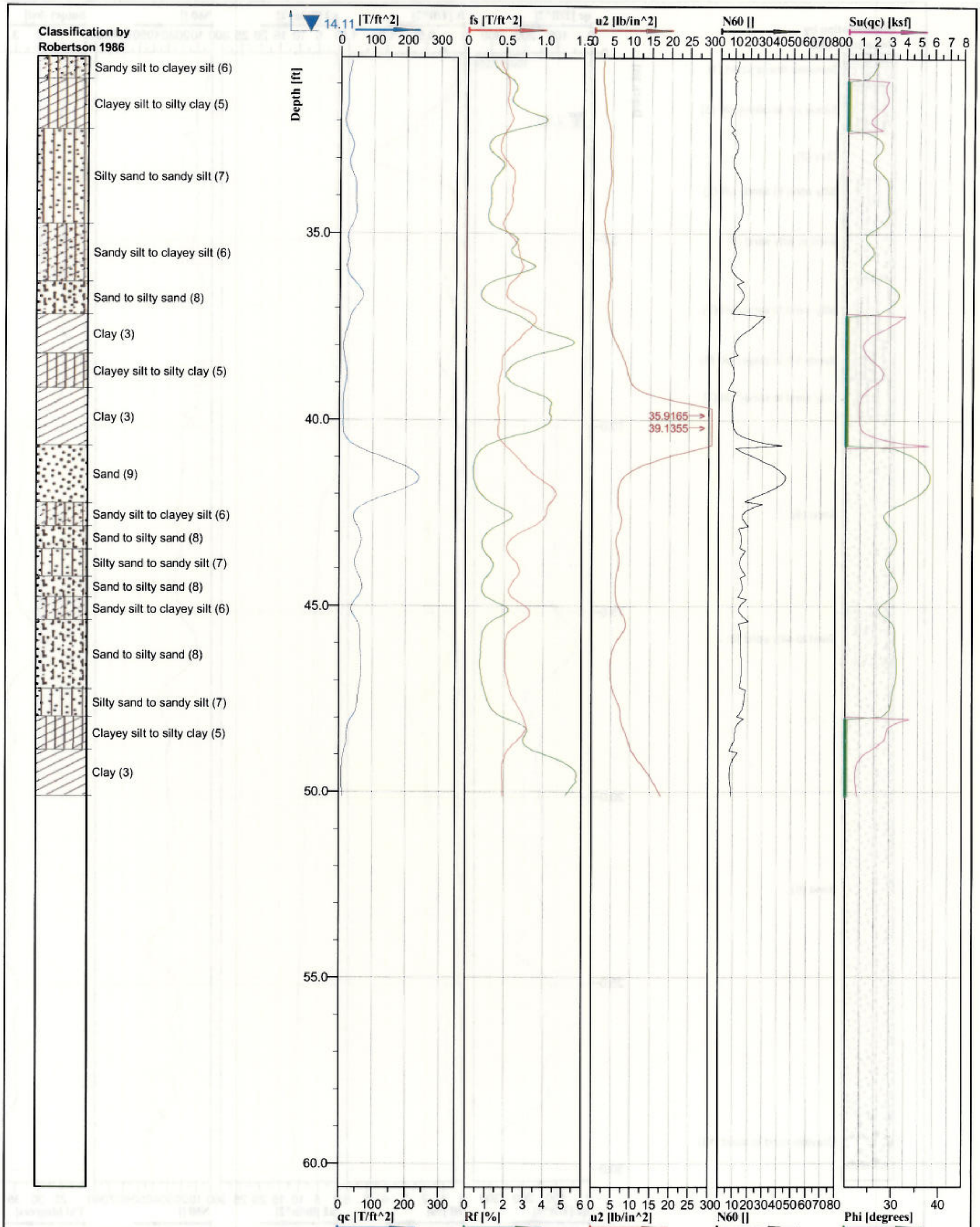
Location: Labadie Power Plant	Position: X: 726302.49 ft, Y: 993187.86 ft	Ground level: 493.64	Test no: P-4
Project ID: 2010012488	Client: Ameren Missouri	Date: 6/24/2010	Scale: 1 : 42
Project: Ash Pond Stability Analysis		Page: 1/1	Fig: 3-4
		File: P-4.cpd	



REITZ & JENS, INC.
CONSULTING ENGINEERS

Cone No: 4274
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Labadie Power Plant	Position:	Ground level: 493.50	Test no: P-6
Project ID: 2010012488	Client: Ameren Missouri	Date: 6/23/10	Scale: 1 : 42
Project: Ash Pond Stability Analysis		Page: 1/2	Fig: 3-5
		File: P-6.cpd	

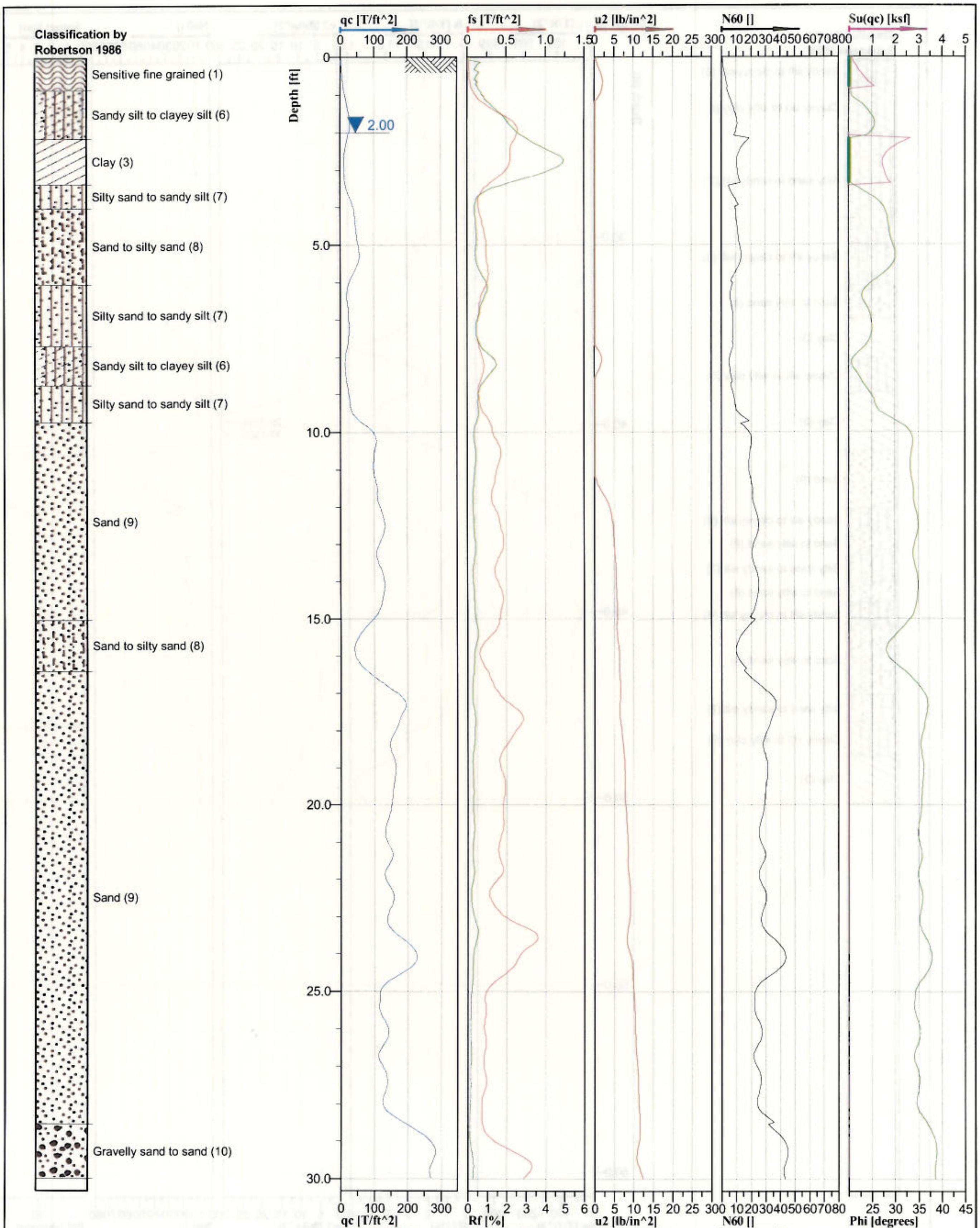


REITZ & JENS, INC.
CONSULTING ENGINEERS

U2

Cone No: 4274
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Labadie Power Plant	Position:	Ground level: 493.50	Test no: P-6
Project ID: 2010012488	Client: Ameren Missouri	Date: 6/23/10	Scale: 1 : 42
Project: Ash Pond Stability Analysis		Page: 2/2	Fig: 3-5
		File: P-6.cpd	

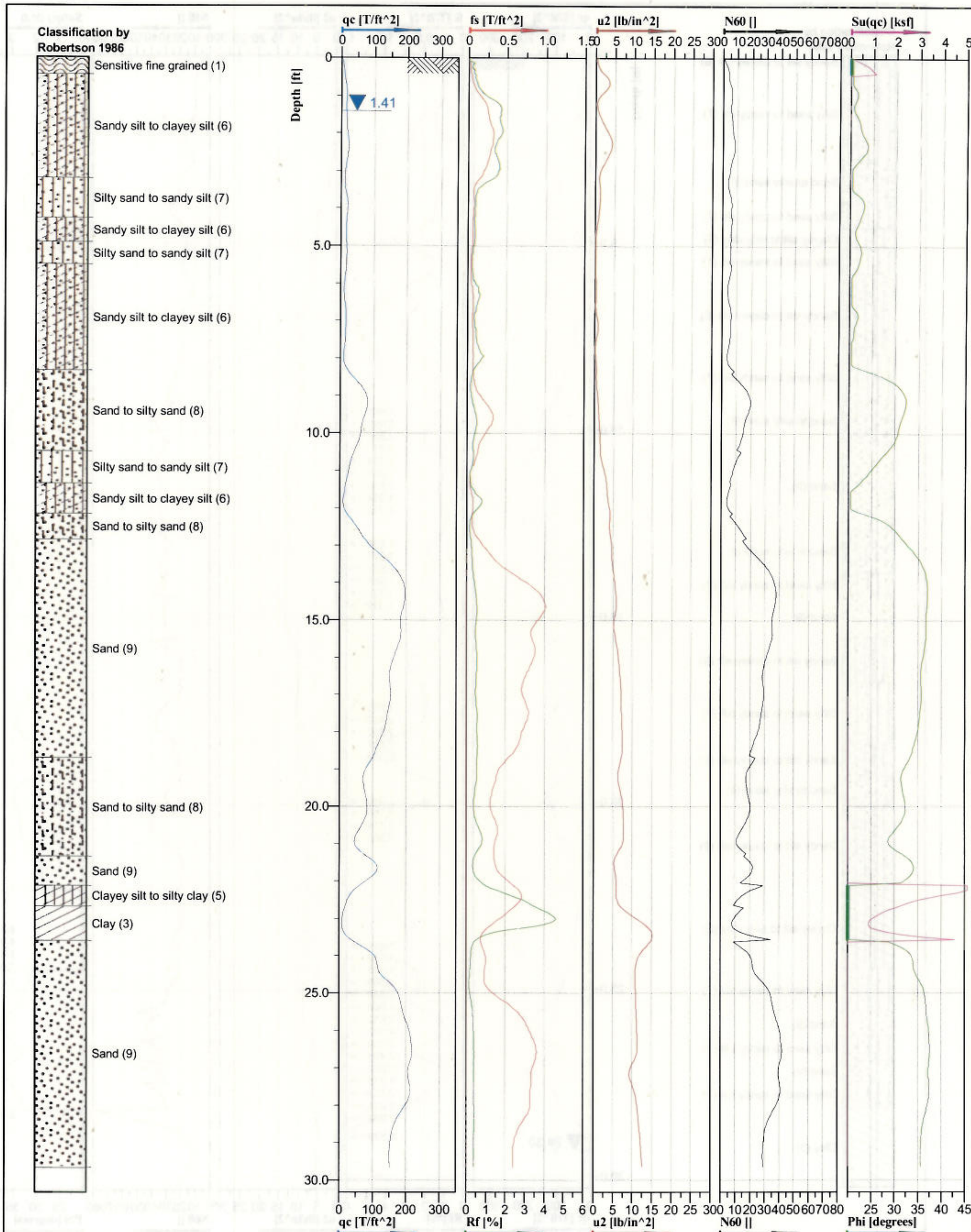


Location: Labadie Power Plant	Position: X: 726383.37 ft, Y: 993189.86 ft	Ground level: 467.19	Test no: P-7
Project ID: 2010012488	Client: Ameren Missouri	Date: 6/24/2010	Scale: 1 : 42
Project: Ash Pond Stability Analysis		Page: 1/1	Fig: 3-6
		File: P-7b.cpd	

REITZ & JENS, INC.
CONSULTING ENGINEERS

U2

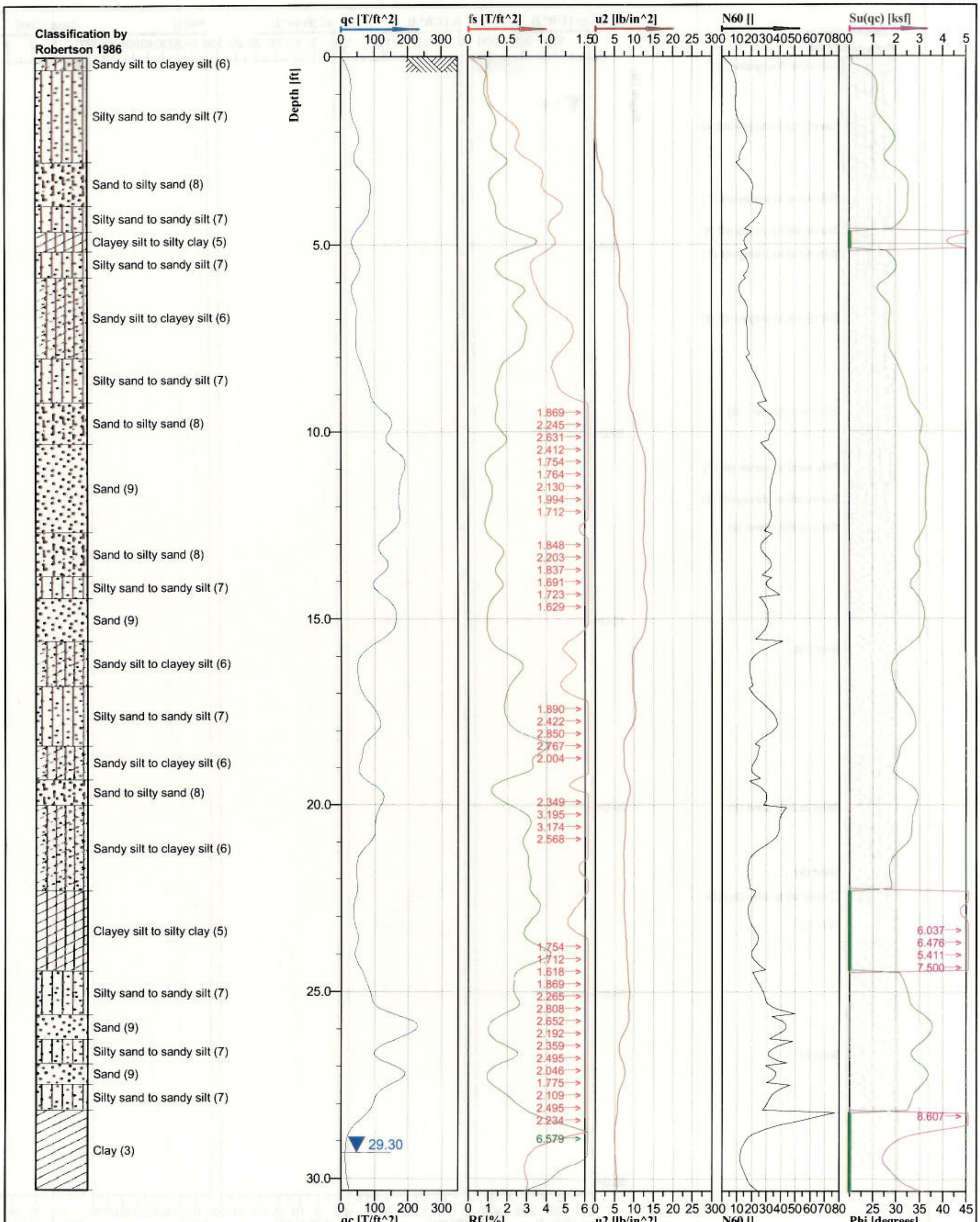
Cone No: 4274
Tip area [cm2]: 10
Sleeve area [cm2]: 150



Cone No: 4274
Tip area [cm2]: 10
Sleeve area [cm2]: 150

REITZ & JENS, INC.
CONSULTING ENGINEERS

Location: Labadie Power Plant	Position: X: 726192.03 ft, Y: 990861.09 ft	Ground level: 466.67	Test no: P-8
Project ID: 2010012488	Client: Ameren Missouri	Date: 6/24/10	Scale: 1 : 42
Project: Ash Pond Stability Analysis		Page: 1/1	Fig: 3-7
		File: P-8.cpd	



Location: Labadie Power Plant	Position: X: 726319.59 ft, Y: 994124.90 ft	Ground level: 493.37	Test no: P-10
Project ID: 2010012488	Client: Ameren Missouri	Date: 6/24/2010	Scale: 1 : 42
Project: Ash Pond Stability Analysis		Page: 1/2	Fig: 3-8
		File: P-10.cpd	

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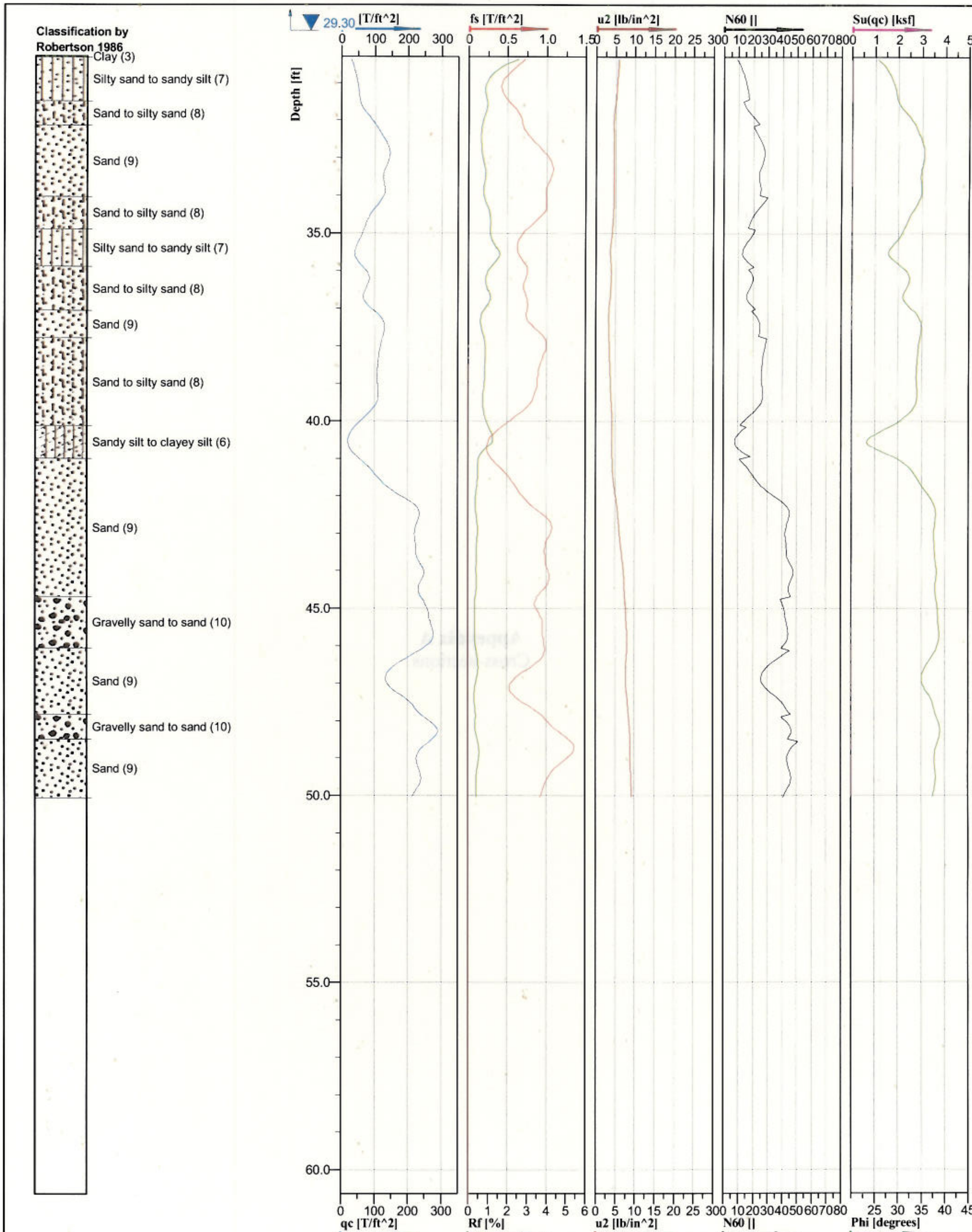
U2

Cone No: 4274
Tip area [cm2]: 10
Sleeve area [cm2]: 150



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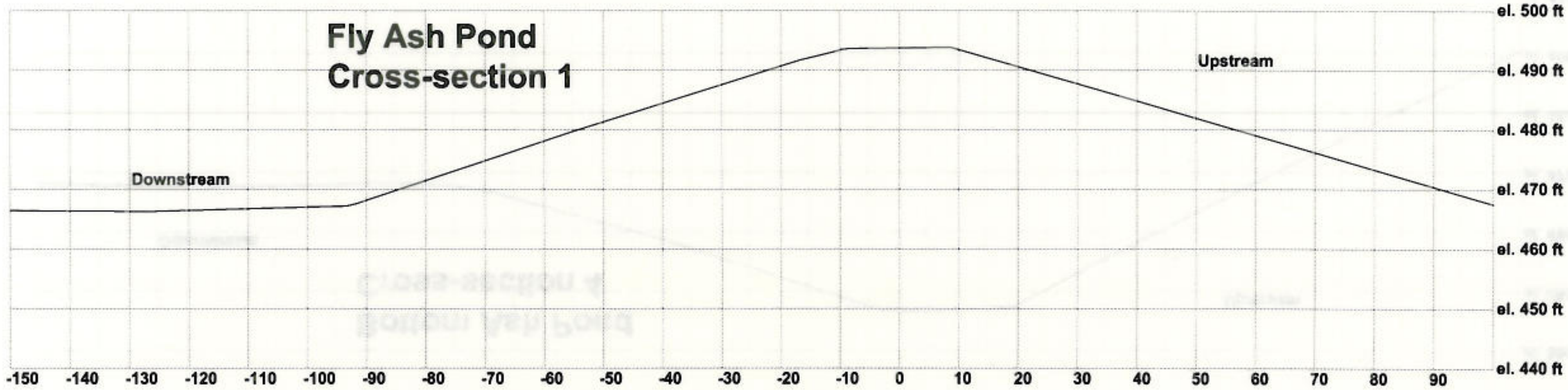
Cone No: 4274
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Labadie Power Plant	Position: X: 726319.59 ft, Y: 994124.90 ft	Ground level: 493.37	Test no: P-10
Project ID: 2010012488	Client: Ameren Missouri	Date: 6/24/2010	Scale: 1 : 42
Project: Ash Pond Stability Analysis		Page: 2/2	Fig: 3-8
		File: P-10.cpd	

Appendix A
Cross-sections

Labadie Power Station



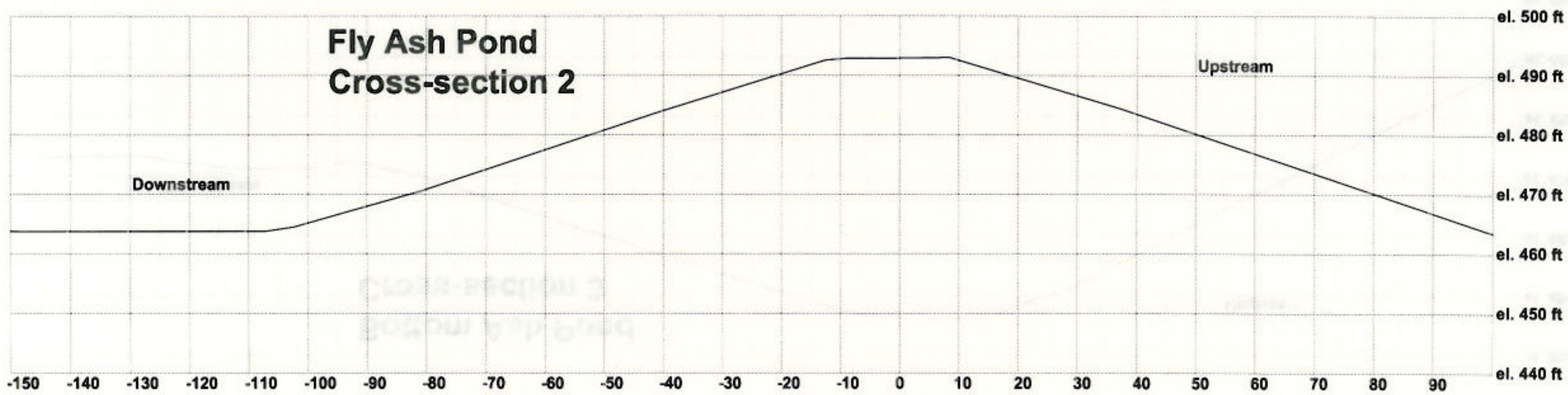


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Figure A-1

Labadie Power Station

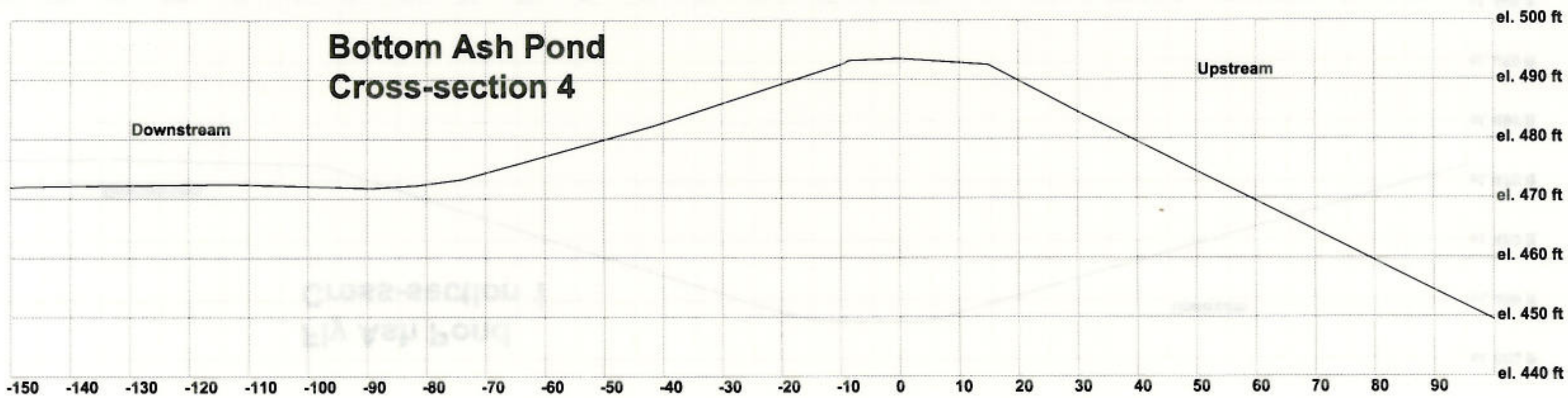

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Figure A-2

Labadie Power Station

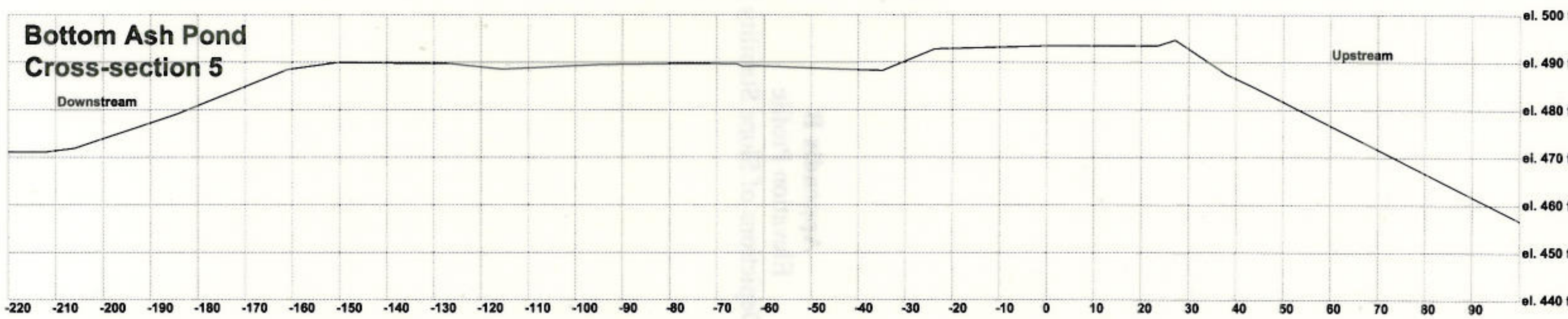

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Figure A-3

Appendix B
Elevation Profile
Graphical Depictions of Slope Stability Models

Labadie Power Station

Elevation Profile

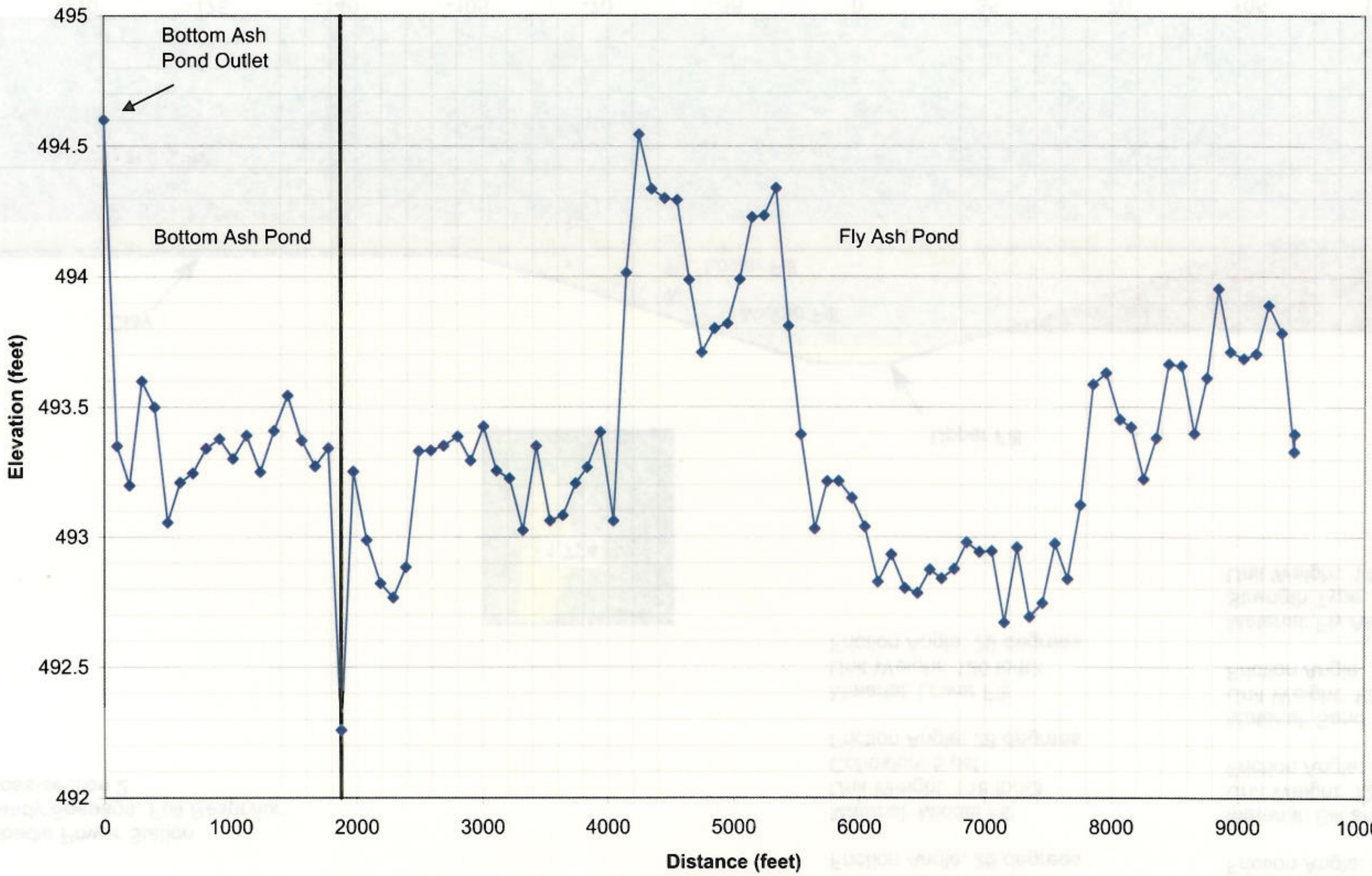

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Figure B-1

Labadie Power Station
Steady Seepage, Full Reservior
Cross-section 2

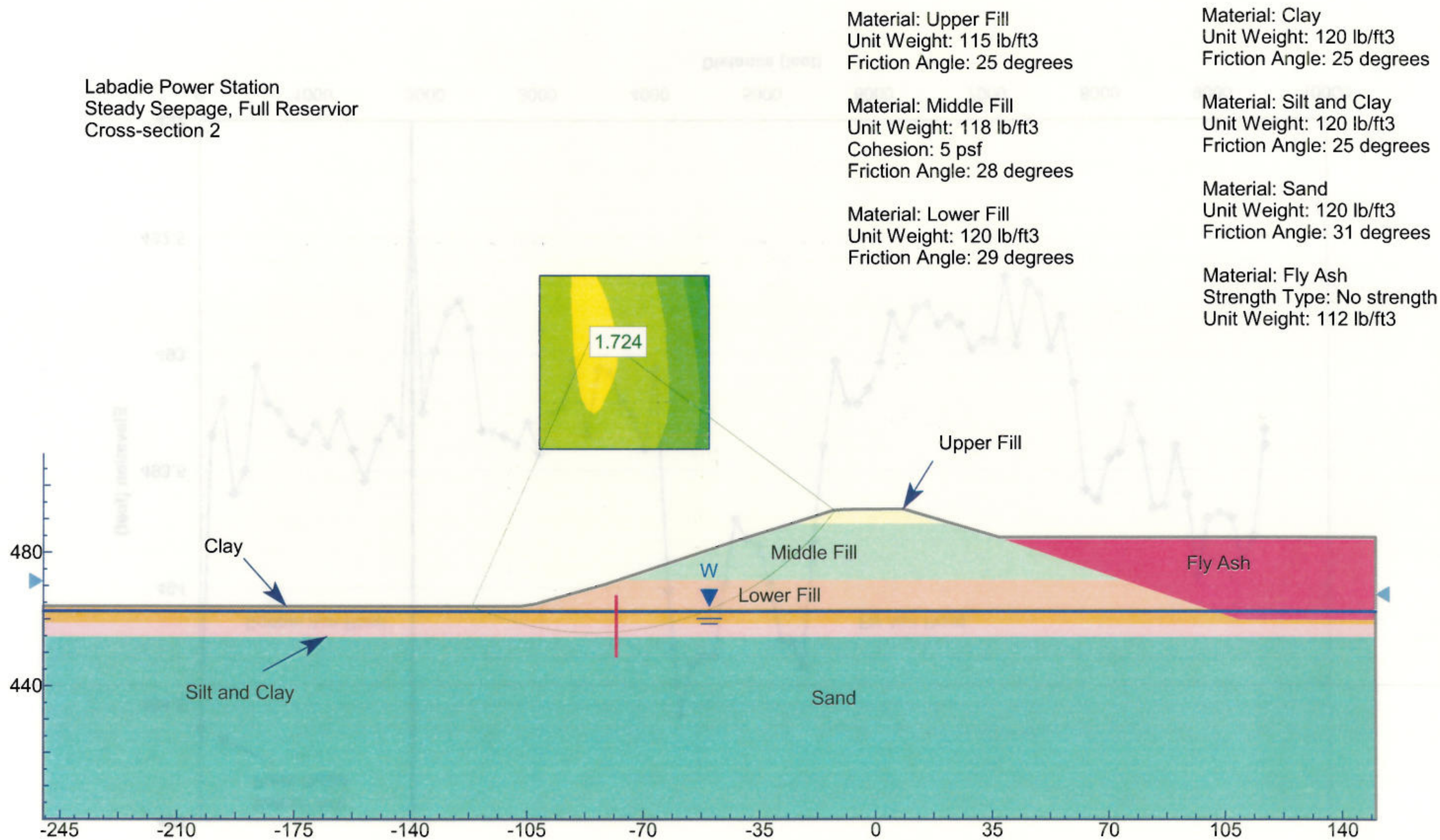

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Figure B-2

Labadie Power Station
Steady Seepage, Maximum Reservior
Cross-section 2

Material: Upper Fill
Unit Weight: 115 lb/ft3
Friction Angle: 25 degrees

Material: Middle Fill
Unit Weight: 118 lb/ft3
Cohesion: 5 psf
Friction Angle: 28 degrees

Material: Lower Fill
Unit Weight: 120 lb/ft3
Friction Angle: 29 degrees

Material: Clay
Unit Weight: 120 lb/ft3
Friction Angle: 25 degrees

Material: Silt and Clay
Unit Weight: 120 lb/ft3
Friction Angle: 25 degrees

Material: Sand
Unit Weight: 120 lb/ft3
Friction Angle: 31 degrees

Material: Fly Ash
Strength Type: No strength
Unit Weight: 112 lb/ft3

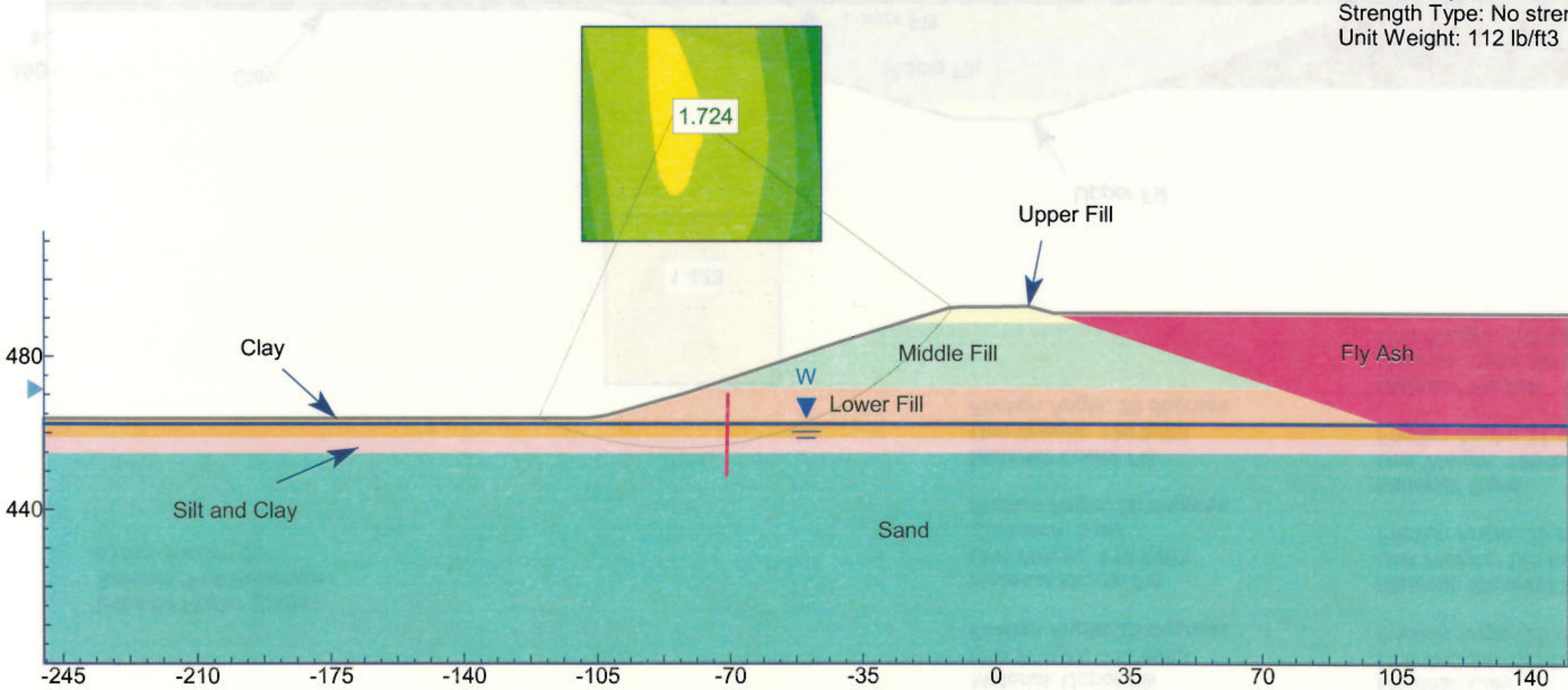

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Figure B-3

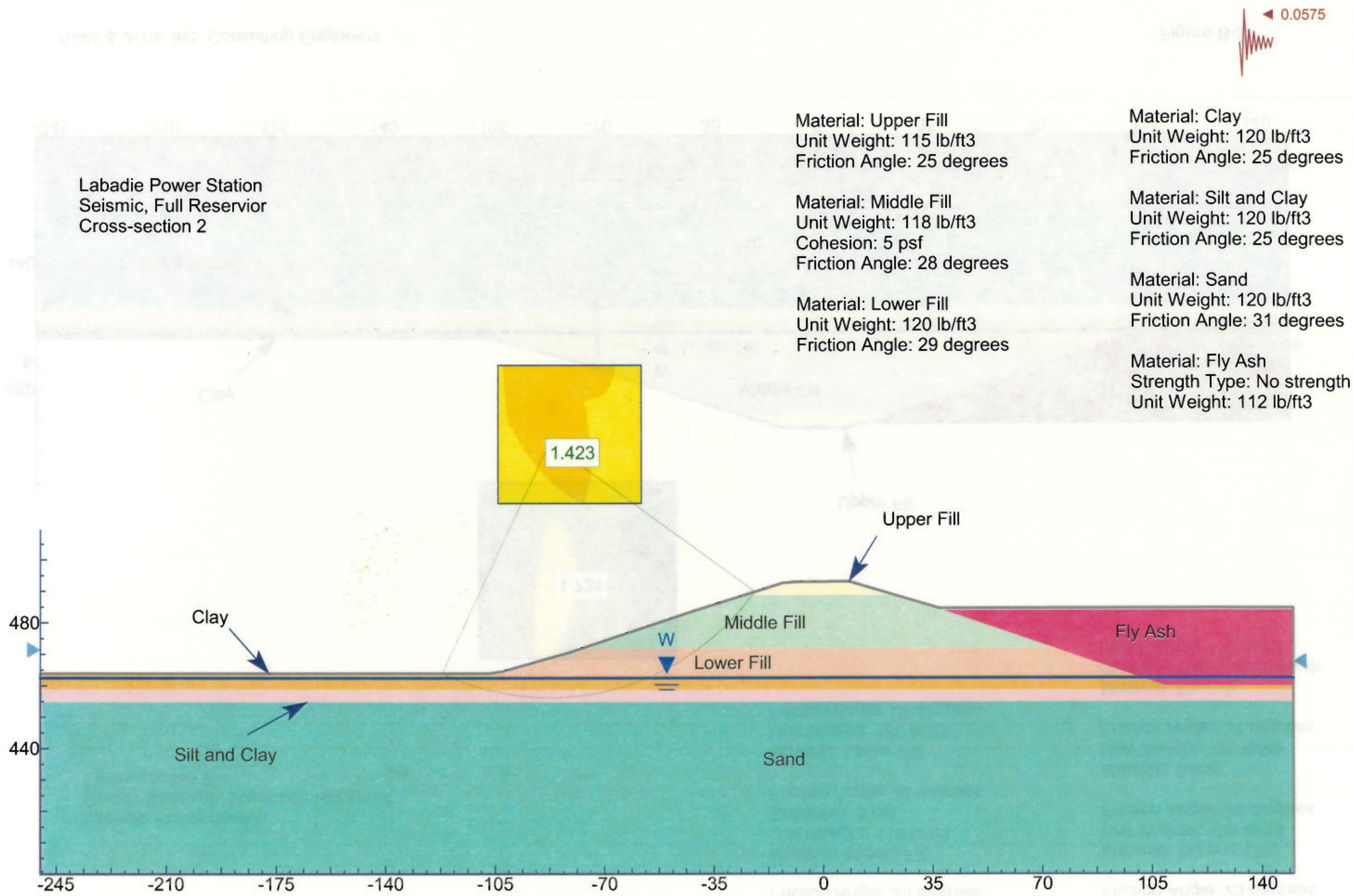

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Figure B-4

Labadie Power Station
Steady Seepage, Full Reservior
(Measured)
Cross-section 3

Material: Upper Fill
Unit Weight: 120 lb/ft3
Friction Angle: 32 degrees

Material: Lower Fill
Unit Weight: 120 lb/ft3
Cohesion: 5 psf
Friction Angle: 30 degrees

Material: Clay
Unit Weight: 120 lb/ft3
Cohesion: 400 psf
Friction Angle: 19 degrees

Material: Silt
Unit Weight: 120 lb/ft3
Cohesion: 100 psf
Friction Angle: 30.5 degrees

Material: Sand
Unit Weight: 120 lb/ft3
Friction Angle: 32 degrees

Material: Bottom Ash
Strength Type: No strength
Unit Weight: 100 lb/ft3

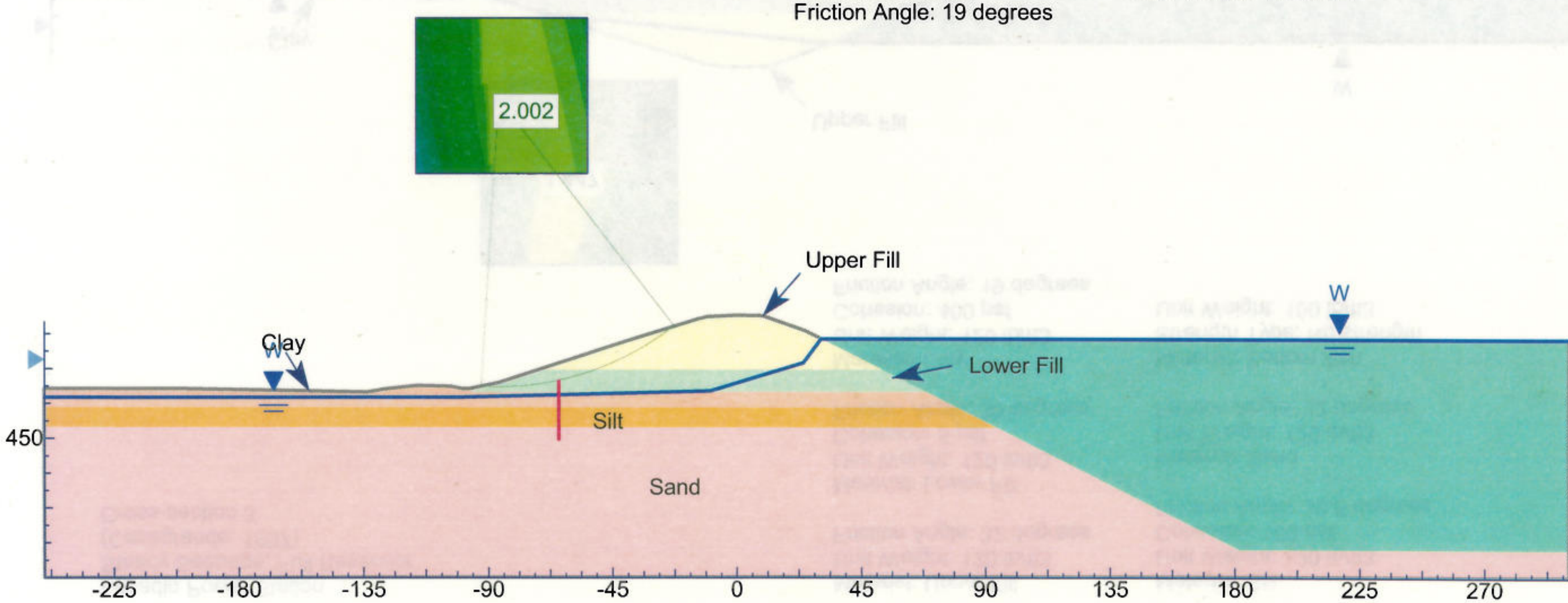

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Figure B-5

Labadie Power Station
Steady Seepage, Full Reservior
(Casagrande, 1937)
Cross-section 3

Material: Upper Fill
Unit Weight: 120 lb/ft3
Friction Angle: 32 degrees

Material: Lower Fill
Unit Weight: 120 lb/ft3
Cohesion: 5 psf
Friction Angle: 30 degrees

Material: Clay
Unit Weight: 120 lb/ft3
Cohesion: 400 psf
Friction Angle: 19 degrees

Material: Silt
Unit Weight: 120 lb/ft3
Cohesion: 100 psf
Friction Angle: 30.5 degrees

Material: Sand
Unit Weight: 120 lb/ft3
Friction Angle: 32 degrees

Material: Bottom Ash
Strength Type: No strength
Unit Weight: 100 lb/ft3

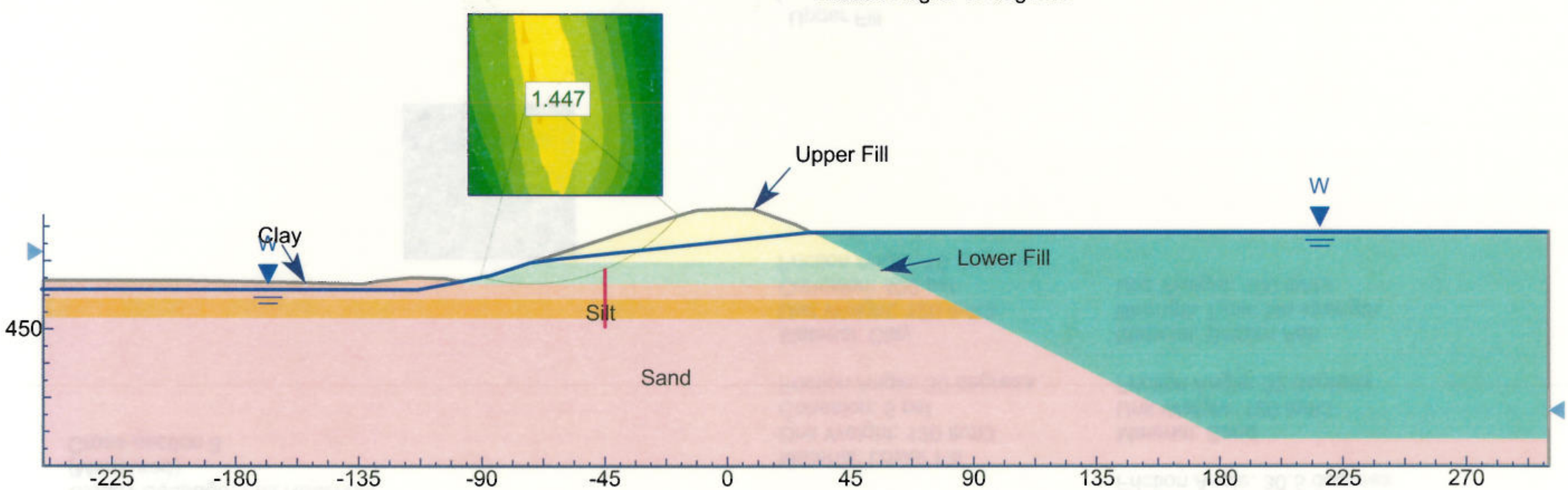

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Figure B-6

Labadie Power Station
Steady Seepage, Maximum Reservior
Cross-section 3

Material: Upper Fill
Unit Weight: 133 lb/ft3
Friction Angle: 32 degrees

Material: Lower Fill
Unit Weight: 122 lb/ft3
Cohesion: 5 psf
Friction Angle: 30 degrees

Material: Clay
Unit Weight: 120 lb/ft3
Cohesion: 400 psf
Friction Angle: 19 degrees

Material: Silt
Unit Weight: 120 lb/ft3
Cohesion: 100 psf
Friction Angle: 30.5 degrees

Material: Sand
Unit Weight: 120 lb/ft3
Friction Angle: 32 degrees

Material: Bottom Ash
Strength Type: No strength
Unit Weight: 100 lb/ft3

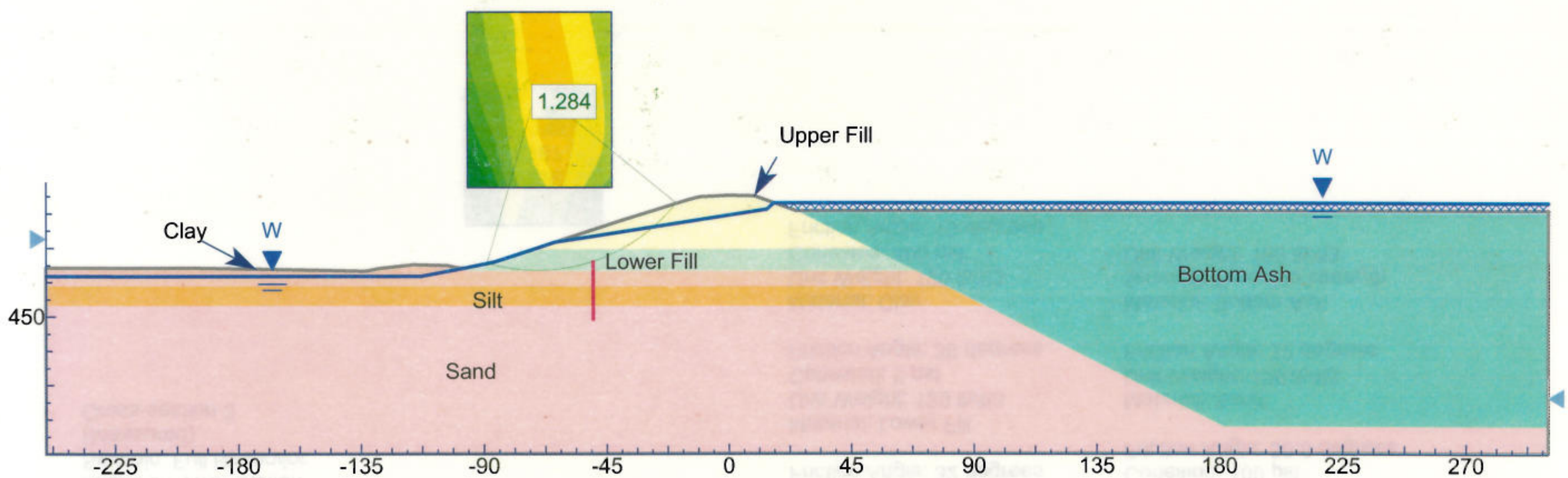

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Figure B-7

Labadie Power Station
Seismic, Full Reservior
(Measured)
Cross-section 3

Material: Upper Fill
Unit Weight: 120 lb/ft3
Friction Angle: 32 degrees

Material: Lower Fill
Unit Weight: 120 lb/ft3
Cohesion: 5 psf
Friction Angle: 30 degrees

Material: Clay
Unit Weight: 120 lb/ft3
Cohesion: 400 psf
Friction Angle: 19 degrees

Material: Silt
Unit Weight: 120 lb/ft3
Cohesion: 100 psf
Friction Angle: 30.5 degrees

Material: Sand
Unit Weight: 120 lb/ft3
Friction Angle: 32 degrees

Material: Bottom Ash
Strength Type: No strength
Unit Weight: 100 lb/ft3

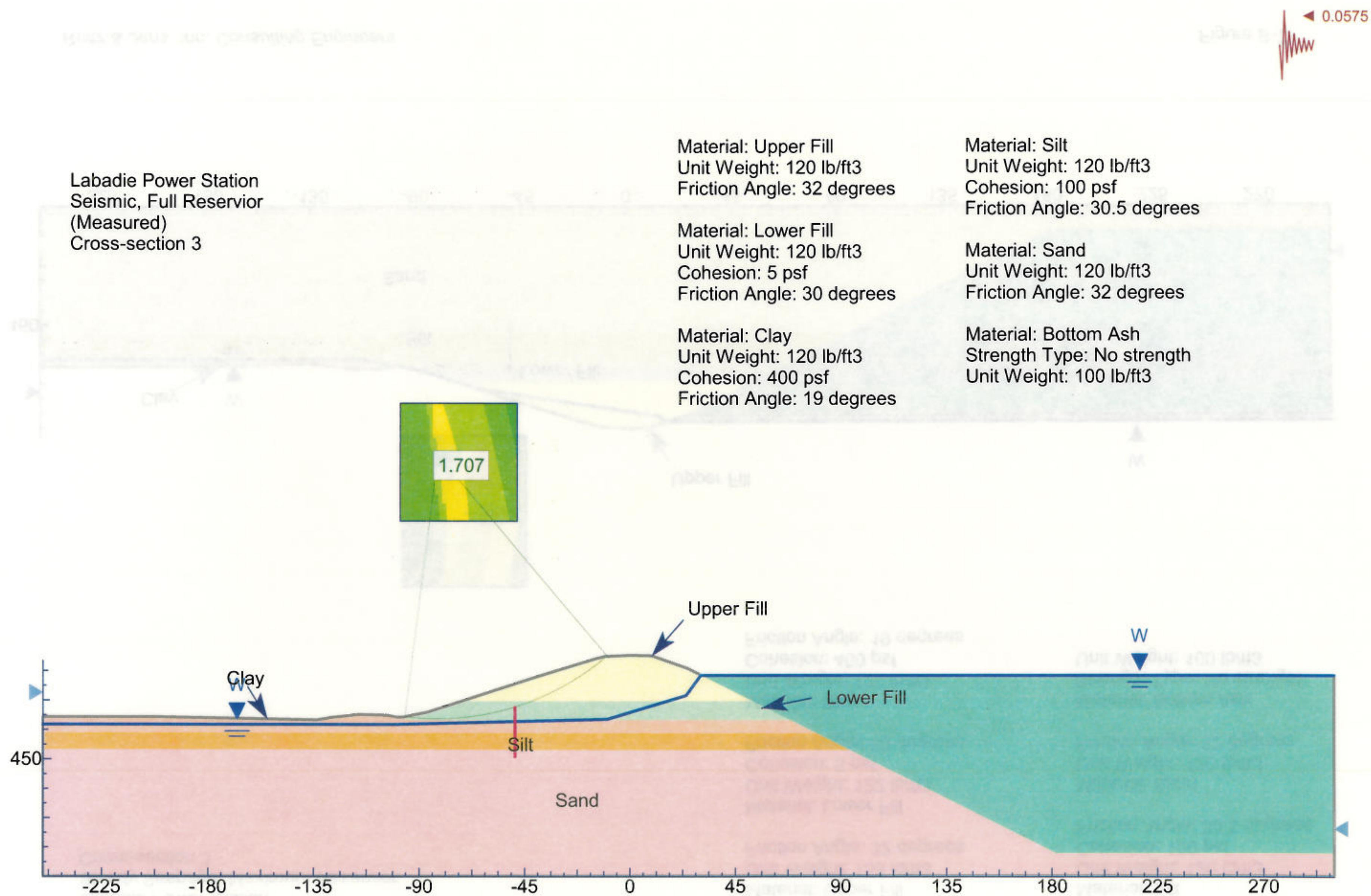

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Figure B-8

Labadie Power Station
Seismic, Full Reservior
(Casagrande, 1937)
Cross-section 3

Material: Upper Fill
Unit Weight: 120 lb/ft3
Friction Angle: 32 degrees

Material: Lower Fill
Unit Weight: 120 lb/ft3
Cohesion: 5 psf
Friction Angle: 30 degrees

Material: Clay
Unit Weight: 120 lb/ft3
Cohesion: 400 psf
Friction Angle: 19 degrees

Material: Silt
Unit Weight: 120 lb/ft3
Cohesion: 100 psf
Friction Angle: 30.5 degrees

Material: Sand
Unit Weight: 120 lb/ft3
Friction Angle: 32 degrees

Material: Bottom Ash
Strength Type: No strength
Unit Weight: 100 lb/ft3

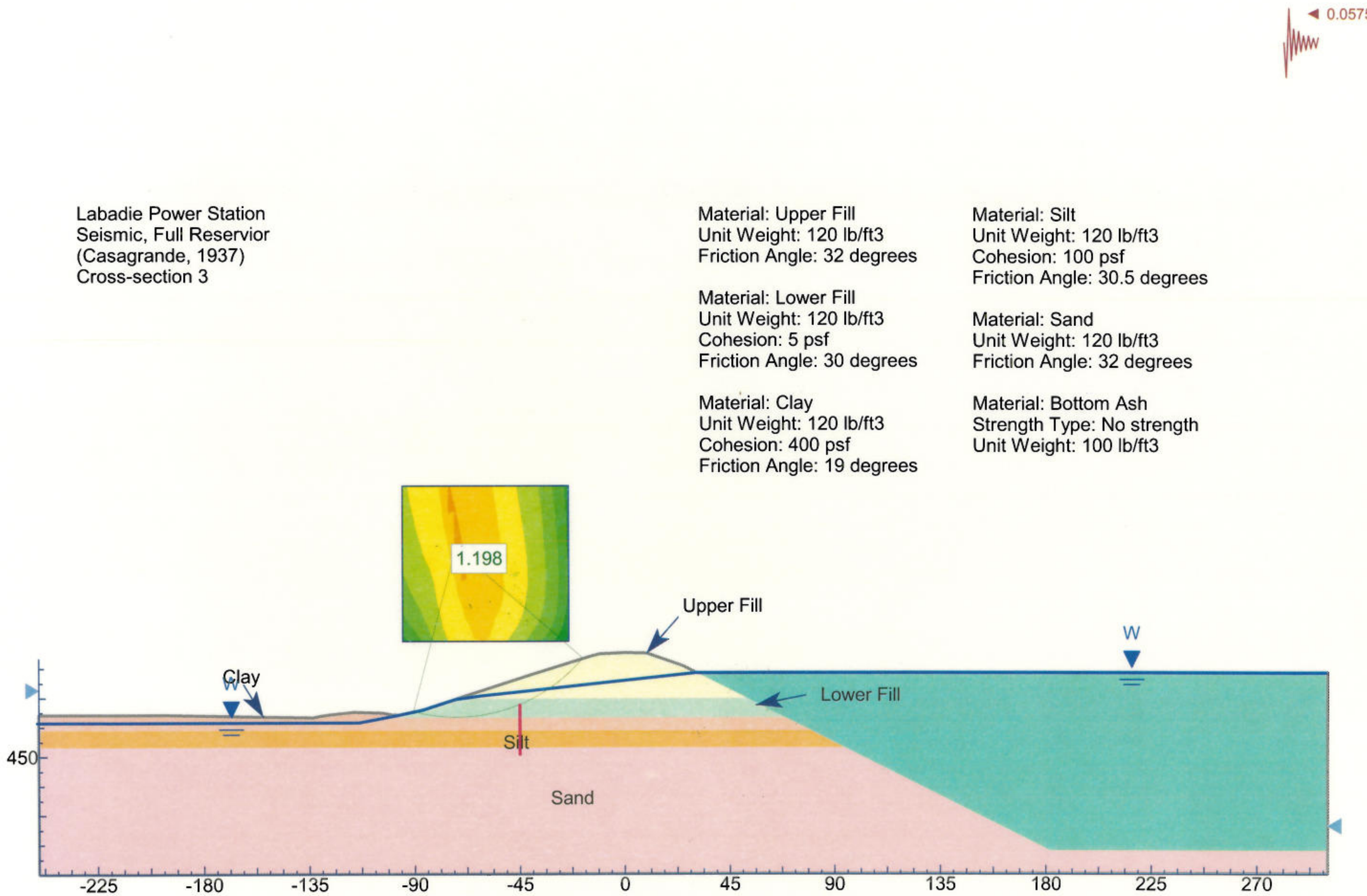

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Figure B-9